OVERVIEW OF THE GLOBAL FOOD AND POPULATION SITUATION

HEARINGS

BEFORE THE

SUBCOMMITTEE ON NATURAL RESOURCES,
AGRICULTURE RESEARCH AND ENVIRONMENT

OF THE

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SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

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OVERVIEW OF THE GLOBAL FOOD AND POPULATION SITUATION

THURSDAY, FEBRUARY 23, 1989

U.S. House of Representatives,
Committee on Science, Space, and Technology,
Subcommittee on Natural Resources, Agriculture
Research and Environment,
Washington, D. C.

The Subcommittee met, pursuant to notice, at 9:30 a.m. in 2325, Rayburn House Office Building, Hon. James J. Scheuer (Chairman of the Subcommittee) presiding.

Present: Representatives Scheuer, Shays, Price, Smith and Walker.

Also present: Congressman Bill Green of New York.

Mr. **Scheuer**. The Subcommittee on Natural Resources, Agriculture Research and the Environment will come to order.

Today we are starting a series of three hearings on one of the most profoundly tragic and challenging missions facing us, the mission of finding an equilibrium between food and people, a mission of achieving a balance between growth in food production and growth in population, growth in food production and growth in people production, one might say.

At the present time 15 million people a year, it is estimated, die of starvation. That is 40,000 people a day. And, in addition, the UNICEF, the United Nations Organization for Children, recently published data in which they indicated that because of the pressure of Third World debt on developing countries forcing them to curtail the pitifully meager programs they have in social services and family planning and food and welfare, that an additional half a million women die a year in childbirth who wouldn't have died had it not been for Third World debt pressures, and an additional half a million kids die a year of intestinal sicknesses and other sicknesses who wouldn't have died if these Third World countries hadn't been forced to curtail their already pitifully inadequate level of social services.

So we are talking about 40 to 50 thousand deaths a day, 15, 16, 17 million deaths a year due to our failure to achieve equilibrium and a rational balance between food and people.

Global food production is increasing at the rate of about one percent. Global people production, the population explosion, which is taking place at a exponential rate in certain parts of the world, like Africa, where in some countries, like Kenya, the population growth rate exceeds what the demographers tell us is the maximum theoretical possibility of population growth, which is four percent.

I see one of our distinguished witnesses nodding.

It's something over four percent, not theoretically possibly, but tragically it's happening. Three-and-half to four percent across the length and breadth of Africa and two-and-a-half to three percent in many parts of Asia and Latin America, and it doesn't take a mathematical wizard to say that if population in the Third World is growing at the rate of three percent and our ability to produce and distribute the food and transport it to where the people are may be increasing at the rate of one percent, there is a two percent per capita lessened annual availability of giving food to people- a two percent per capita reduction in food availability, and that is the tragic mission that we are working with today.

I am waiting for the Ranking Republican Member of the Subcommittee, Claudine Schneider of Rhode Island, and she will be here very shortly.

We are very honored to have with us a new Member of the Subcommittee, Chris Shays of Connecticut, and, one of the really most intrepid and intelligent and thoughtful Members of Congress in the whole area of contraceptive rights, family planning and women's welfare, Congressman Bill Green of New York.

Bill, we are honored and delighted to have you here today.

Mr. GREEN. I just want to thank you for inviting me and other Members of the House to joint this very important session.

Mr. SCHEUER. Well, we are delighted and honored to have you, Bill. We always know that when you show up you're going to make a thoughtful and constructive contribution.

Now I'm going to call upon my two colleagues for remarks, but let me just set the stage.

So this is the scenario that we're facing. How can we achieve equilibrium between food and people, and without so overstressing the resources of the earth that we tend further to accelerate the growing rush towards degradation of our ecosystems and degradation of this fragile planet earth in which we are all inhabitants?

We know that trying to raise too much food on a fragile infrastructure can cause agricultural land to collapse and revert to desert. We know that if we draw too much water and see a reduction in watertables we're looking doom in the face. We know that we if stress marginal land, that land can collapse. We know that if we use too many chemicals, insecticides, fertilizers and the like, that can degrade watertables.

There are all kinds of ways in which the urgent pressures to produce more food in the short run can produce incalculably harmful problems in the long run which are inordinately expensive to solve, if you can solve them at all.

So this is the conundrum that we're faced with, how do we achieve equilibrium and sanity in this planet by achieving a balance between food and people?

In today's hearing we will hear testimony from experts in the area of crop strain improvement, the challenge to the world institutions of agricultural research to produce crops that are relevant to the small farmer in the Third World who has available to him very little in the way of inputs of capital for fertilizer, for irrigation and so forth, the kind of crop strains and indeed the kind of animal strains that are appropriate for small-scale, Third World farmers without the availability of large capital inputs.

Unfortunately, most of western agricultural research is designed for a farmer who can afford $300,000 combines and who has unlimited inputs of capital for fertilizer, irrigation and what-not, and the marvelous agricultural infrastructure we have developed in this country is virtually irrelevant to the Third World. We ought to pay more attention to them in terms of relevant and appropriate agricultural research.

So I'm delighted that we're having some witnesses this morning that are going to be talking about crop strain improvements, biotechnology, soil agroecology, mariculture and commodities. They will outline the technical options available around the world to meet the problems posed by the imbalance between food and people.

In subsequent hearings we'll examine the environmental consequences of certain agricultural practices that we adopt in this desperate effort to produce more food in the short run.

We will hear from experts who have studied the role of women in agriculture, the social pressures, the so-called cultural baggage which favors large families despite the pitiful lack of resources and support of all kinds to raise those families in even a minimum quality of life.

And then our series on the third day will conclude with a briefing by a distinguished group of parliamentarians from all over this globe, men and women, many of them with whom I have worked over the last 10 years as part of the global community of parliamentarians on population and development, and they will provide us with their insight into policies, local, national, regional and global, which must be altered, which must be changed and adapted and massaged if we are to meet the very basic needs of humankind for food.

I will now turn to Congressman Shays for comments.

Mr. SHAYS. I have no comments at this time, Mr. Chairman.

Mr. SCHEUER. I do want to say that Chris Shays is a new Member of the Subcommittee, and I'm delighted he has shown up this morning and we look forward to working with you with great pleasure.

Congressman Bill Green.

Mr. GREEN. Thank you very much, Mr. Chairman. Again, let me express my appreciation for your willingness to invite Members of Congress who are not part of this Subcommittee to hear this important testimony this morning.

I would like to make really just one observation. As you know, Mr. Chairman, I am the Ranking Republican on the HUD Independent Agencies Appropriations Subcommittee, and that Subcommittee originates the appropriation for EPA, the Council on Environmental Quality and it's also relevant to NASA with its incipient Mission To Planet Earth Program.

It struck me as the issue of global climate change has come to popular attention this past year that there is very little linkage made in the public mind between that issue and the issue that you are highlighting today.

Yet, it seems to me that there is a most important linkage because the fact of the matter is that human activities at a given per capita level, which might not be very damaging to the ecosystem with the world having a human population of two billion, but it may start to be very, very damaging to the ecosystem when the human population is five billion, and even more devastating if the human population reaches 10 billion. You are looking not just at the ozone layer, but issues like loss of the tropical forests, desertification and issues which directly impact on the subject you are discussing today.

So I think it is important as we become aware of these global climate issues to recognize that they are really part of a seamless web with this whole issue of how population is stressing our environment and what that means for the whole ecological system of the globe.

So I congratulate you, Mr. Chairman, on scheduling this series of hearings and I know what we learn from it will be extremely useful to all of us in the House.

Mr. SCHEUER. Thank you, Congressman Green. Two things encourage me very much.

First, the President's appointment of Bill Reilly as head of the EPA. I have heard him speak several times. He is direct, he is forthcoming and he is making it perfectly clear that he is breaking with the past and he is going to do something, and he specifically mentions the whole laundry list of items that you mentioned.

I think he can make it here in Washington, and the reason I believe that is because I got a Christmas card from him. I have never met the gentleman, but I have heard only good things about him. I got a Christmas card from him and it's a picture of him and his wife in the middle of the African tundra with an enormous big python curled around his neck and his shoulders and around his wife's neck and shoulders, and he and his wife are both perfectly happy and confident there with this monstrous serpent around their necks.

I think the message he clearly meant to send was that if he can cope with the snakes in the bush, he can certainly cope with the snakes in Washington. So I got that as a very positive message.

[Laughter.]

The second thing that encourages me is that Congressman Bill Green is sitting in the cat bird seat on the Appropriations Committee, in that most critical spot where we are fighting for funding for all the programs that everybody in this audience cares about and desperately hopes will be properly funded.

You're one of our great white hopes, Bill, and I'm delighted you're there and I'm delighted that you're here.

So, first, we'll hear from our opening witness, Dr. John Stover, Vice President of the Futures Group, who will give us an overview of the global food and population situation.

We are delighted to have you, Dr. Stover.

STATEMENT OF DR. JOHN STOVER, VICE PRESIDENT, THE FUTURES GROUP

Dr. STOVER. Thank you, Mr. Chairman.

[Lights dimmed for slide presentation.]

What we have prepared for the brief testimony this morning is a presentation that examines the effects of population growth on environmental degradation and resource exhaustion.

This presentation concerns itself only with the effects of population growth on environment and natural resources.

Mr. SCHEUER. Excuse me, would you suspend one second.

There are a whole bunch of seats that are unoccupied in this first row. If so many Congressmen show up that we can't handle them in the second row, we'll probably ask you to move, but in the meantime any of you who would like to move from where you are to inhabit these seats for this little slide show, you're more than welcome.

[Audience members move to the first row at the Chairman's invitation.]

Dr. STOVER. I don't mean to suggest by focusing this presentation just on the effects of population growth, that this is the only factor that affects the environment and natural resources. So I want to make that point at the outset that we are focusing just on this one factor. But population growth is an important factor because it affects all areas of the environment.

Mr. SCHEUER. Excuse me, would you go back one slide to look at that "rapid." Wasn't there a slide that went past very fast that gave the title of this—

Dr. STOVER. The slide that went past very fast was my advertising for the Futures Group.

[Laughter.]

Mr. SCHEUER. Didn't it say something about "rapid"?

Dr. STOVER. This presentation was developed under a project funded by A.I.D. that the Office of Population called Rapid.

Mr. SCHEUER. That's correct, and I think it's important to note that it has been developed by A.I.D. Hasn't it been used by Marshall Green, Ambassador Marshall Green?

Dr. STOVER. Yes, it has been used by Ambassador Green and a number of others to make presentations to leaders of developing countries.

Mr. SCHEUER. I wanted to make that point. I think that is very important for us to know that leaders in the Third World, leaders in sub-Saharan Africa, Chiefs of State, Health Ministers, Defense Ministers and Industry Ministers, they have all benefited from this show. It was really designed for them, and this is the first time I have had a chance to see it. I have known about it, and I'm absolutely delighted to have the chance to see it.

Dr. STOVER. Well, what you're going to see this morning is something that is a little bit different. What we have done is pull very simple examples from four different countries around the world, Egypt, Honduras, Jordan and Botswana to very quickly illustrate the relationship between population growth and arable land pasture, land and water resources in those four countries.

So I'll begin with the relationship between population growth and arable land taking as two examples Egypt and Honduras.

Egypt has a population today of about 50 million. Its growth rate is somewhere between 2 and 2.5 percent, which means it is adding a million people about every nine months to its population.

Now, as most of you know, Egypt is essentially a desert country with most of the population living in the narrow strip along the Nile. Only four percent of the land area is arable, and that is also where the people live.

What we are showing you here is a picture of the town of Tanta, which is a city of about 200,000 people located in the middle of the Nile Delta. This is the fertile agricultural area of the Nile.

This is the way it looked in 1972. The red areas are those areas that were urbanized and the green are those areas that are agricultural. This is a 10 kilometer radius around the center of the city of Tanta. This information is taken from Landsat photographs, the satellite that circles the world and takes photographs of earth resources.

This is what it looked like in 1972. Ninety percent of the area was agricultural. By 1982 this is what the picture looked like. Because the people live where the agricultural land is, as the population expands and urban areas expand, more land is required for houses, commercial buildings, roads, et cetera, and all of that expansion is taking place onto agricultural lands. So that by 1982 you can see how much the green area, agricultural land, was taken out of production because of urban construction.

If we project this forward to the year 2000 with current rates of population growth in Egypt, you can see what the situation looks like by the year 2000. From 90 percent agricultural, this area around Tanta would turn into about 50 percent agricultural and 50 percent urban. This is a serious problem for Egypt and other areas that have limited land resources.

At the same time, the population is growing and therefore requiring more food to feed it. The resource for providing that food, the land base, is being eroded by the expanding urban areas.

Now in Egypt the solutions to this problem, (and there are several possible solutions): One is to import more food or to ask for more food from U.S. Food For Peace Programs. Another one obviously is to increase yields on the existing land, but when population is growing at 2.5 percent, that means that yields on the existing land also have to increase at 2.5 percent just to keep pace. To make up for the arable land that is being lost, yields have to increase another half a percent. So that a reduction in population growth would free some of those benefits from new technology to be used for making up for land that is being lost.

The second example is from Honduras in Central America with a population of about 5 million and a growth rate of over three percent.

This chart looks at the distribution of arable land in Honduras. Currently a little over two million hectares of land are cultivated, and experts who have studied the situation tell us that about another half a million hectares of land are appropriate for cultivation. So that ultimately about 2.5 million hectares of arable land are available.

Now, what I want to do is add some bars to this chart showing the amount of land that would be required to provide every rural family with enough land to earn its own livelihood. This is based on the norms that were established by the Honduras Agrarian

Reform Act of 1975 which specified a five hectare plot of land for every rural family.

That's the amount that will be required in 1980, 1990, the year 2000 and the year 2010. This assumes a continuation of the three percent plus growth rate in Honduras. It also assumes continued migration of the population from rural to urban areas. So this is not the full three percent growth rate we're seeing.

But what you can see is that simply the growth of the population would make it impossible, given the land base in Honduras, to provide an adequate farm for each rural family.

Now of course land is not distributed in five hectare parcels in Honduras. The land distribution is very unequal. So that population growth is not the only contributor to this problem. However, I think this chart illustrates that the pressures of population growth make it very difficult to solve the other political and economic problems that are associated with this.

Again looking at the year 2000, the population of Honduras would be about 3.6 million urban and about 4.4 million rural. Of that 4.4 million rural population, about 2.5 million people could be supported on the arable land base if it were distributed evenly.

Now Honduras also has large forest reserves. Our calculations are that about another million people could be supported by the forest reserves if they were developed as a forest resource. In other words, these are people who will be foresters and people who would take care of the forests, about another million people.

Unfortunately that leaves under this high population projection about a million landless, and these people will be doing two things. One is more rapid migration to the cities and the second is they will be cutting down the forests looking for land that they don't have. Already this pressure to encroach into the forests for arable land has caused the destruction of about two million out of the five million hectares of forest land in Honduras.

The reason this is bad is because most of this forested area is on very steeply sloped land that is not adequate for agriculture. Once you take one or two crops off of it, the rains wash away the top soil and you end up destroying the land.

So the ultimate solution is of course that most of these people will be going to urban areas and seeking jobs. The trouble is that if the population is growing at three percent, this flood of migrants into the urban areas is going to be much higher than the ability of the economy to create jobs for people in the urban areas.

A slower rate of population growth, however, would mean a slower flood of migrants to the urban areas and a longer period of time for the urban economy to generate productive jobs for them.

The next example is one that looks at pasture land, and the example that I have chosen for this morning is from Botswana. Botswana is a southern African country with a population of about 1.5 million and a growth rate of almost four percent.

In Botswana the major source of wealth for the rural population is cattle. Each of these little figures represents a half a million head of cattle, and today the cattle herd in Botswana fluctuates between 2.5 and 3 million, depending on rainfall.

Given the current high rate of population growth in Botswana, just to maintain the present ratio of cattle to population in the rural areas would mean that the cattle herd size would have to increase to about 6.5 million by the year 2010. Well, such an increase could only be achieved in one of two ways, either by increasing the density of grazing on the current grazing land or by expanding the amount of grazing land.

Currently there are about 2.5 head of cattle grazing on every 10 hectares of land, and the experts who have studied this say this is about what the land can support. In other words to increase the herd size to about 6.5 million, that density of grazing would have to increase to about 6.5 head per 10 hectares. This is far beyond the capacity of the land to support it and would lead to overgrazing and desertification.

Well, the second solution then is to expand the grazing land. This is a map of Botswana showing in blue the protected areas and swamps in the country. The area where cattle are currently grazing, as you can see, are most of the other areas of the country, including some incursion into the protected areas already.

To expand the cattle herd from 2.5 million to 3.5 million would mean opening up new lands along the periphery here and would also likely lead to more incursion into the protected areas. To actually think about expanding to a herd size of 6.5 million would require grazing over just about the entire country because most of this land would be very unproductive for grazing.

Well, again, just like we saw in Honduras, this is a future that is not likely to occur, and the solution is that other types of activities will have to be found for the rural population, other sources of wealth and other sources of employment. A slower rate of population growth would give the economy more time to generate the productive jobs that these people will require.

Next I would like to turn very quickly to the issue of water and take an example from Jordan.

Jordan has a population of about 2.8 million on the East Bank, and I'm just speaking of the East Bank of Jordan now, and a growth rate of almost four percent. This is one of the highest growth rates in the world. It's brought about by a total fertility rate, an average number of children per woman of about seven.

Now Jordan is a relatively arid country with few sources of water. So the engineers have investigated very thoroughly all the sources of water available in Jordan. This line shows the current water available and projections of what can be developed into the future. This line here is about the maximum that could be available in Jordan if all sources of water, rivers, streams, rainfall and underground aquifers, if all sources were tapped, everything except bringing icebergs from Antarctica.

This water needs to serve several purposes. The amount required for municipal and industrial purposes is show here in these bars. Today only about 20 percent or so of water is required for municipal and industrial demand. But given the high rate of population growth of about four percent and efforts to increase the consumption per capita, it would seem that by the year 2010, even with a doubling of water available, some 50 percent of all this water would be required for municipal and industrial purposes.

Well, the rest of the water is available for irrigation, and in Jordan only 10 percent of the land is irrigated, but that land produces 50 percent of the agricultural output.

So I can now extend these bars to show you how much water would be required in order to irrigate enough land to support the growing population.

As you can see because of the growing population and therefore demand for municipal water supply, the amount of water left over for agriculture would be no higher in the year 2010 than it is today, even if water supplies could be doubled.

What this means of course is the amount of irrigated land, even with new technologies, will not be able to increase very much, and Jordan will experience increasingly larger and larger deficits in its balance of agricultural trade. This is quite serious for Jordan since it already depends to a very large extent on external sources, money from Saudi Arabia, money from the United States, money from Kuwait and other areas as well as remittances from its workers that are working in the Gulf States to support the population.

Finally, a few concluding slides.

When we look at environmental systems such as grasslands, fish stocks, et cetera, one of the interesting aspects is that most of these systems can recover from overuse once to twice. For example, grasslands if they are overgrazed can recover with the next rains maybe in a year. Fish stocks, depending on the species, might recover in 5 or 10 years.

A forest, the trees can be regrown in 20 years, but to actually reproduce the whole forest ecosystem could require 100 or 150 years.

The key point here is that when population is growing at say three percent, it doubles in 20 to 22 years. So when populations are doubling every 20 years, it doesn't give these systems time to recover when they are overutilized.

This chart shows in terms of agriculture the relationship between population density and the level of technology required. At very low levels of population density, slash and burn agriculture is sufficient, even though it only provides one crop maybe every seven years on a particular piece of land, and then the land is left fallow for six years or so in order to recoup its fertility, but this is adequate at low levels of population density.

At higher and higher levels of population density we have to use more intensive technology in order to get one or even more crops per year on every plot of soil. The problem that population growth adds to this equation is that many areas of the world are moving very quickly from low population density to high population density much more quickly than they are able to go from low levels of technology to intermediate or higher levels of technology.

So what's happening is that we are trying to support high or medium levels of population density using low levels of technology. Slash and burn agriculture, for example, shortening the cycle not from seven years, but down to two years, and that kind of inappropriate use of low-level technology in high density areas leads to resource exhaustion.

So population is important in this equation of population, environment, natural resources and food because it affects all areas. I haven't talked about forest or coastal resources, atmosphere or flora and fauna, but there are similar relationships there. So even though population is not the only factor affecting these problems, it's a very important one because it affects them all.

As we look to the future, the benefits of slower population growth I think, can be summed up in three points.

One is that the ultimate population densities when you look at stable populations being achieved sometime in the next century or by the year 2100 would be considerably lower. So the requirements for our ecosystems to support population would ultimately be less if slower population growth can be achieved today.

Secondly, more time would be available for developing and implementing the effective concentration measures that are required. Slowing population growth by itself does not solve our problems. There are a whole series of technological and political actions that need to be taken to solve those problems. Slower rates of population growth buys us more time to develop those solutions and to implement them.

And, finally, slower rates of population growth also add to more rapid social and economic development. This is very important because more rapid social and economic development is going to be required in the developing countries in order for them to have the resources both at the family level and at the national level to fund and to absorb the changes that will be required to protect our environment and natural resources.

Thank you very much.

Mr. **Scheuer**. Thank you, Dr. Stover.

We have been joined by Congressman Lamar Smith of Texas, and we are delighted to have you, Congressman, a new Member of our Subcommittee.

Congressman Green, do you have any questions you would like to ask the witness?

Mr. **Green**. No.

Mr. **Scheuer**. Congressman Shays, any questions?

Mr. **Shays**. No.

Mr. **Scheuer**. At the International Conference on Development that just ended this last couple of days here in Washington at the Washington Convention Center, Dr. Jessica Tutman Matthews stated that population was the core problem from which all global environmental destruction stems.

Dr. Stover, do you think this is a fair appraisal of the basic situation facing the planet?

Dr. **Stover**. Yes, I think that's a fair statement. As I said before, population is not the only cause, but it's the root cause.

I think when we look at some of the problems that are facing us, it's clear, for example the Amazon forest in Brazil, that a slower rate of population growth today is not going to solve the problem of the deforestation of the Amazon in the next five years.

However, rapid population growth in the past in Brazil has contributed to this problem, and I think more importantly as we look to the future in order to avoid the same kind of problem in a country such as Zaire in Africa, it is slower rates of population growth today that are going to make those problems less severe and make them solvable 20 years from now.

Mr. **Scheuer**. The global food problem, this disequilibrium between food and people, is it caused by our inability to raise enough food? Is it caused by political and economic problems in distributing the food and transporting the food to where the people are? What is the principle cause of our inability to raise and deliver food to where the people are who urgently need it?

Dr. **Stover**. Well, it you look at worldwide food production, you could draw a hypothetical calculation I think and show that if all the food in the world were distributed equitably to each individual and each individual only received as much as they actually needed to survive, that there would be enough food in the world to feed everybody.

However, the realities are that that doesn't happen. Farmers raise food either for themselves or to sell and somebody has to have the money to purchase it and not all food can be transported all over the world. So we have to look within the borders of particular countries at their ability to raise food to feed their own people.

Mr. **Scheuer**. And frequently within regions of the country.

Dr. **Stover**. And even within regions.

Mr. **Scheuer**. Don't we have problems in Ethiopia of getting food to where it's delivered through the various foreign aid programs to where the people are?

Dr. **Stover**. Exactly, and Sudan is another good example. The problem that population growth creates here is that it's a double-edged sword. At the same time that population growth is increasing, the population that needs to be fed, it's also impacting the resources in terms of land and other things that we have to produce the food. So that we need more food to feed the growing population, but we have fewer resources to grow that food. So that population growth has a double impact on hunger and on poverty.

Mr. **Scheuer**. From the point of view of an individual country designing agricultural public policy, let us say, what are the pros and cons of their designing a public policy aimed at encouraging cash crops for export or encouraging a whole set of public policies which would develop technologies and seeds and production methods that would facilitate food production, a distribution aimed at their local population within the country?

Dr. **Stover**. Well, as you're well aware, this is a problem that, unfortunately, goes way beyond just solving the problem of feeding people because when countries decide on agricultural policy they are looking at not only the problem of feeding their people, but they are also looking at the problems of generating foreign exchange to pay off their foreign debt.

It's well known that there has traditionally been an urban bias in development policy and population contributes to this also. Developing country politicians are quite worried about keeping the urban population happy because that is their political base. Rapid growing urban populations require food. Not only do they require food, but they require affordable food.

So there is a tendency among policymakers in developing countries to subsidize food brought into the urban areas. This means that there may be fewer incentives because the prices are lower for farmers in the rural areas to expand production, and there may be fewer resources available for them to expand production. The result is that the incentives aren't there and they move to urban areas and it makes larger and larger populations in the urban areas for the politicians to worry about.

So the problem is not so much that it's impossible to solve these problems in the abstract, but in the real world of trying to make policy in the developing countries in light of such problems as external debt, rapidly growing urban populations and destruction of the environment in the rural areas. All of these problems come together to make it very difficult for them to solve their agricultural problems.

Mr. SCHEUER. You talked about external debt. You've heard a lot about the principle of debt for nature swaps, in other words, the principle under which the developed countries will help the developing countries with rescheduling of debts and readjustment of debts in return for an agreement that the developing countries will join the developed world in living up to higher standards of ecological and environmental behavior, let us say, and that would include stopping the raping of the tropical rain forests, stopping the distruction of biodiversity, the processes that lead to desertification and deforestation and so forth.

What ideas do you have as to how this could be done and how it could be structured to be feasible both to the developed countries who hold the debt and to the developing countries who owe the money, but who also are very antsy about invasions of their sovereignty and their right to dispose of their natural resources the way they wish? There is sometimes, from time to time, inability to view a tropical rain forest as a global resource. They look upon it as our tropical rain forest and we have the right to do with it as we wish.

Dr. STOVER. That is definitely true. Just last week I was in Brazil talking to policymakers about the rain forests in the Amazon, and I can tell you that most of the Brazilian policymakers do not see the problem anywhere near the way we see the problem.

Mr. SCHEUER. Just to engage in this little practice of one-upmanship, last year I was in Guatemala looking at their ran forests and the government people have exactly the same feeling there. They pretend to a general feeling that this is a valuable resource, and they know it's valuable and they know it's an irreplaceable resource, but when it comes down to practical policies of limiting production and going to a sustained yield method of exploiting the forests on a sustainable basis, they are quite antsy.

Dr. STOVER. I agree, and there are some real parallels here I think between the effort to develop sound environment policies in developing countries and the effort to develop population policies.

Fifteen to 20 years ago the international population community talked mainly about the problems of world overpopulation and how it was important for countries all over the world to control their population growth because the world couldn't support so many more people, and those arguments fell on deaf ears because a policymaker in Botswana is not mainly concerned about world overpopulation. He is concerned about Botswana.

Well, it's the same thing if we talk about tropical rain forests or any kind of environmental protection. People in Brazil are not mainly concerned about the global greenhouse effect. They are concerned about developing Brazil and about poverty and jobs in Brazil. So that to the extent that we harangue Brazilian policymakers about how they have to protect the forests in order to avoid the global greenhouse effect, we are not going to be very effective, and we're going to generate a defensive reaction among policymakers in developing countries that immediately when they hear about environment, they are going to say, oh, those people are going to come and tell us what to do to save the world.

I think what we have to do is in the policy dialogue with developing countries, is put it on their terms. Why should Brazil save the tropical rain forests for Brazil, what are the resources in the forests that Brazil is losing by destroying the forests? And there are lots of them.

Something like a third of all the pharmaceuticals in the world contain products from the tropical rain forests, and who knows how many other pharmaceutical products waiting to be developed have components existing in the Brazilian rain forests that Brazil is losing that resource when they cut down the forests. I think that is one of the keys to pursuing this dialogue in the future.

Mr. **Scheuer**. You probably noticed an article on the front page of last Sunday's New York Times about Brazil and her rain forests and the Japanese wish to come in there and build a $300 million railroad that would make that tropical rain forest instantly accessible to high-tech transport to the Pacific port and to Japan. It sent the shivers up and down my spine, and what it indicated is that the problem is both in the developing world and in the developed world.

That the Japanese would want to do that, or that they would want to do that without imposing an absolute requirement for development or for cutting of the tropical rain forests on a sustainable yield basis really boggles the mind.

There has got to be an international or a global consciousness out there somewhere, and if the Japanese can't afford an environmental conscience in the fashion in which they drain resources out of the developing world, irreplaceable global resources really, if they can't afford a conscience, if they can't afford to impose some kind of restraint and some kind of enlightened standard of environmental behavior whose central focus would be sustainable development, if they can't afford that and they don't have the resources to do that, what country in the West would?

I hope that Japan will be encouraged to engage in this global process of swapping debt for nature and that they will become leaders in that since they are the leading capital rich country in the world. I hope very much that we can have discourse with the Japanese and bring them to the point of realizing that they can be a key player in preserving some of these priceless environmental heritages and that they can provide the capital and they can provide the leadership and the insight to make sure that sustainable yield is the criterion by which they and others would participate in the development or the exploitation of Third World resources.

I don't mean to use that word "exploitation" of resources in a pejorative or negative way. A resource exploitation program that is based on the sustainable yield concept is a perfectly positive program. Nobody expects Brazil's tropical forests or any of the other tropical forests to remain pristine and untouched by mankind, but if they are to be preserved, then they must be farmed, let us say, on a sustainable yield basis. Just as we farm the land and we farm the oceans on a sustainable yield basis, we just farm our forests and exploit our forests in the same way.

I can't think of a more clear object lesson in the horrendous choices that we are faced with than that Sunday New York Times Magazine article, that front page article, and I would ask unanimous consent that that article be included in the record at this point.

[The article referred to follows:]

In Amazon, Road Is a Dream, But to Ecologists a Nightmare

By MARLISE SIMONS
Special to The New York Times

RIO BRANCO, Brazil — When Flaviano Melo, the young Governor of Acre, holds up his favorite map, it shows a new highway stretching west from the Amazon rain forest, across the Peruvian Andes and down to the Pacific coast. There it joins a giant arrow pointing to Japan.

When environmentalists look at the same map, they see a road that will accelerate deforestation of the rain forest by providing a new and shorter supply route for the world's largest consumer of tropical hardwood.

The 500-mile highway, which would link existing road systems in western Brazil and neighboring Peru, is still only a plan. But Mr. Melo has already begun negotiating financing for the $300 million project with the Japanese Government.

An Invitation to Tokyo

If built, the new route would open up huge tracts of mostly undisturbed rain forest now reachable only through the vast grid of rivers that drain this western corner of the Amazon.

"That road fits us like a glove," said Mr. Melo, explaining that the people of this isolated and poor state are currently unable to market forest products like wood, resin, rubber and nuts. "If Japan wants wood, we have it, and we can also think of selling our products to the rest of the world."

Japan's new interest in the western Amazon, which prompted it to invite Governor Melo to Tokyo in late 1987, reflects its enormous demand for tropical hardwoods used mainly in construction. As supplies are rapidly dwindling in the forests of Southeast Asia, timber tradesmen said, Japan and other importers have begun looking more carefully at Brazil's extraordinary untapped forestry reserves.

Later this month in Brasília, Japan is

Continued on Page 20, Column 1

The New York Times

SUNDAY, FEBRUARY 19, 1989

razilian Looks to Japan to Link Amazon to Pacifi

Continued From Page 1

ocing a seminar for traders and mers to discuss the future develop- nt of the tropical timber industry in tin America. The region currently pplies only 8 percent of the world's trade in tropical timber, most of it rom Brazil.

Tokyo's interest in the highway has apidly become the latest topic in a growing international debate about the impact that migration, development and deforestation are having on the Amazon basin.

Protests From Environmentalists

As news of the project has leaked out, it has triggered protests from environmental groups in the United States, Europe and Japan, who clamor for the protection of South America's great equatorial rain forest because it anchors fragile soil, holds at least half of the earth's animal and plant species and plays a vital role in world climate.

Alarm over the road project is heightened by a new and belated awareness of the devastation that has followed construction of other highways into the Amazon basin, above all the BR-364, which sweeps northwest from Cuiabá. More than a million migrants have moved up this road through Mato Grosso and Rondônia in the last decade, and settlers and loggers have razed the jungle along its 800-mile route.

Here in Rio Branco, the far-western city at the end of the road, the debate over the forest has gained added drama because it was near here that two months ago a well-known leader of er tappers, Francisco Mendes, murdered, apparently by cattle hers who felt threatened by his paign to keep the forest intact.

ow, once again, the controversy r the new highway is pitting the sures of migration and development against the interests of conserva- , showing the dilemmas that Brazil- n federal and state authorities face they seek to design a single strategy for the Amazon.

Placed a Tax on Logs

Governor Melo of Acre is not an enemy of the forest. When he first moved into office two years ago, he stopped what he now calls the "indiscriminate and uncontrolled" cutting of valuable trees by putting a 100 percent tax on logs. Most of these were destined for the United States. Infuriated lumber barons here threatened to kidnap the Governor before a local court revoked the legality of the decree.

"In Acre we are forest people and we have an interest in protecting it," said Mr. Melo, speaking in his office in a stately white mansion, a memento of the time when this small river port was at the heart of Brazil's rubber boom a century ago. Today, rubber tapping and nut collecting remain the state's main economic activity and Acre depends on the federal Government for 85 percent of its income.

But Acre needs roads, Mr. Melo insisted, noting that its forest products now travel 2,000 miles of meandering rivers to reach the mouth of the Amazon and the Atlantic coast. Fuel, staples and other products not transported by air arrive here along the same staggering route.

A road to Peru is an old dream of this region, Mr. Melo continued. Even if Acre is connected to Brazil's road system, Lima will still be only 1,000 miles away compared with the 2,500 miles to São Paulo and Santos, its Atlantic port.

The controversial route to the west now exists as a mud track through the jungle. It crosses a dozen rivers and is passable only a few weeks a year, leaving more than half the state's 400,000 people isolated. Rubber tappers, nut collectors and fishermen along the way complain that middlemen pay a pittance for their products because of transportation difficulties.

The Japanese plan for the exit to the Pacific means paving a 300-mile stretch from Rio Branco to Pucallpa in Peru at a cost of $300 million. The close to 500-mile stretch across the Andes from Pucallpa to Lima, although in poor condition, already exists.

Acre's neighbors, the states of Rondonia and Mato Grosso, have also started pressing for the project. Both have timber to sell from their remaining stretches of rain forest and Mato Grosso, after clearing jungle, has become one of the Brazil's main producers of meat, soybeans and other grains. With an outlet to the Pacific, Mato Grosso's Governor has said the state can cut costs and compete with American grain exports to Japan.

On a recent trip south of Rio Branco, the one paved road toward Xapuri and then to Bolivia, offered a view now so familiar in the Amazon: on both sic huge tracts of rain forest had b felled and burned. Its only occupa were charred trees and wandering c tle herds.

Safeguarding the Forest

Inevitably, environmentalists f that similar destruction will hap along a Peru road, above all one c ceived to export timber.

"In many ways this may be Bra last opportunity to show they ca things right in the Amazon by pu in the proper protection beforeha said Thomas Lovejoy of the Smit nian Institution who has just vis Rio Branco. "If not, it could be a turning point. If 40 percent of the A zon is deforested, the rest may ed," he said. Researchers estimate between 15 and 20 percent of the A zon's primary forest has been cle in the last two decades.

An official of the International Tropical Timber Association, which has its headquarters in Japan, said that greater demand for Amazon timber was almost inevitable. "Even if world consumption remains stable, Indonesia and Malaysia should run out of commercial species in the next two decades," the official said.

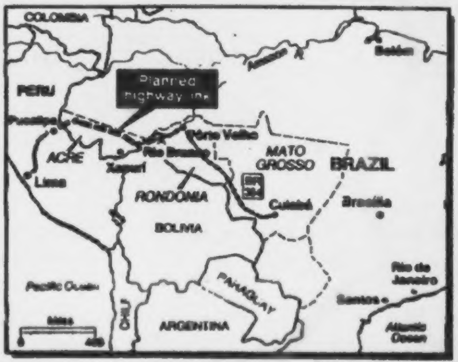
Mr. Melo insists that he will declare forest reserves along the road to prevent penetration and, if given the funds, he will safeguard Indian and rubber tappers' land. Wood will be extracted, he added, only through careful forest management.

Studies Due in March

Studies of the road's economic viab ity and environmental impact are d in March, but Mr. Melo believes a co tract with the Japanese Government Overseas Economic Development Co poration and the construction may st be some time off.

"We had rather build the road no because in my administration we w put in protection," Mr. Melo said. " don't care who pays for the road b the Japanese are the only ones th have shown interest."

The World Bank and the Inter-American Development Bank, which ha been severely criticized for their nancing of portions of the road into western Amazon that brought huge est devastation further to the sou have not discussed the road to Pe



The New York Times/Feb. 28, 1989

Planned highway link has stirred concern for rain forest.

Mr. **Scheuer**. We have been joined by Congressman David Price of North Carolina. We are delighted to have you here, Dave.

I yield to my colleague from North Carolina.

Mr. **Price**. Thank you, Mr. Chairman. I have no questions at this time. I do commend you for convening this hearing and looking forward to hearing from our fine panel of witnesses.

Mr. **Scheuer**. I thank you.

Do any of my other colleagues have a question? Congressman Green, thank you very much for coming.

Let's keep this very informal this morning, and if either of you, Chris Shays or David or Lamar, if you have a question while I'm talking or while the witness is talking, just interrupt. There aren't so many of us here that we can't keep it very informal.

I just have one or two more questions and then we'll move on to the next panel.

In determining which are the key elements that are going to move the question of supply and demand of food in the world in the future, what rank or what role or what weight would you give to such factors as global warming, ozone depletion and environmental degradation of all kinds that we have seen? How will they affect the ability of our globe to supply its growing population?

Dr. **Stover**. Well, I think you need to look at that in two ways. If you look at the long-term ability of us to feed ourselves, these are by far the most crucial aspects, and we don't know enough about them yet to know just how they are going to affect our ability to feed ourselves, but because they will be possibly changing the climate of the earth, it's no question that they are going to play the major influence in our long-term ability to feed ourselves.

In the short term I would just like to reiterate the point that I made. These are concerns that the international donor community needs to keep very much mind as they review the development programs that we support and that we fund.

However, within an individual country context we are not likely to see much concern for these kinds of global issues, and the short-term solutions to their problems will come from a realization of actions that they need to take in order to improve their own situation within their borders.

Mr. **Scheuer**. Do any of my colleagues have any questions?

Mr. **Shays**. No.

Mr. **Price**. No.

Mr. **Scheuer**. All right. John Stover, thank you very, very much for your testimony and for your most interesting slide show. As I say, I've heard about it, and I'm absolutely delighted to have the chance to see it. It's particularly important for us to see what our country had enabled you and people like Ambassador Marshall Green to show to important leaders in the Third World to raise their level of consciousness as to the importance of producing in their countries rational population policies as well as rational sustainable growth of food production policies.

Thank you very, very much. We are grateful to you.

We will now call our major panel to the witness table.

Dr. Robert Chandler, World Food Prize Winner, who will be speaking on crop strain improvements; Dr. Hillel Gordin, Director of the National Center for Mariculture of the Israel Oceanographic and Limnological Research Institute, who will speak to us on mariculture to produce high quality dietary protein; Dr. Pedro Sanchez of North Carolina State University.

I will ask Congressman Dave Price of North Carolina, to introduce Dr. Sanchez right now.

Mr. PRICE. Thank you, Mr. Chairman.

I want to welcome our entire panel, but to extend a particular welcome to Dr. Pedro Sanchez who is appearing today before the Subcommittee.

Dr. Sanchez is a Professor of Soil Science at North Carolina State University in Raleigh. Since 1972 Dr. Sanchez has been the coordinator of the university's tropical soils research program. His expertise and his years of experience in the field of soil science and his work in sustained food production with tropical soils should give us a unique insight into this issue.

He brings us today I think a hopeful report and a very important report concerning the sustainable agricultural options to slash and burn agriculture that can drastically retard tropical deforestation rates.

So we look forward to his testimony very much this morning, and I want to extend my personal welcome.

Mr. SCHEUER. Thank you very much, Congressman Price.

Then we will be hearing from Mr. Ronald Trostle, Chief of the Commodity and Trade Analysis Branch of the Department of Agriculture, who will speak to us on 10- year projections for world food production, and, last, Dr. Luther Val Giddings from the World Bank, from their Agriculture and Rural Development Program who will address the question of whether agricultural biotechnology can solve the global food deficit problem.

Well, are there any of you who are under time pressure to leave?

[No response.]

Then what I would like to do for the Members of Congress is to have some questions for each witness after they have testified because I have found that when we have five witnesses and they all testify, by the time the fifth has testified you have really forgotten the things that you wanted to ask the first guy and it all becomes a big jumble.

This is all off the record.

[Laughter.]

So we'll keep this very informal. There are only four Members here and we'll spend a few minutes asking questions of the witnesses, and then when they are all finished we'll undoubtedly have some more and maybe even the witnesses may have questions to ask of each other. That is perfectly appropriate, and we would enjoy some cross-fertilization not only between the witnesses and the Members up here, but between the witnesses themselves.

All right, why don't I introduce you all in the order in which you appear here.

First, Dr. Robert Chandler who is a World Food Prize Winner for his great work in crop strain improvement. So we'll hear from Dr. Chandler first off.

Please take your five or six minutes and then we'll have a few questions for you at that time, and then perhaps at the end when all of you have testified we'll have some more questions.

Let me say that I would ask unanimous consent for any of the Members of Congress to submit questions that we didn't have time to get answered by mail and to hold the record open for two weeks to receive the answers to those questions.

I would also like to inform all of you that the full text of your statements will be printed in the record at the point in which you testify.

So, Dr. Chandler, please proceed for five or six minutes.

STATEMENT OF DR. ROBERT CHANDLER, WORLD FOOD PRIZE WINNER

Dr. CHANDLER. Thank you, Mr. Chairman.

As you know, I was the first Director of the International Rice Research Institute in the Philippines, and this was the organization that sparked the Green Revolution in rice. Rice of course feeds about 2.5 billion people, a staple food for 2.5 billion people in the world, even though we don't consume too much here in the United States.

Mr. SCHEUER. That's about half of the global population at the present time.

Dr. CHANDLER. Yes. The Asian population is about 3 billion now, and 2.5 billion of those people approximately or slightly more are dependent upon rice, and 90 percent of the world's rice is grown and consumed in Asia, even though it's an important crop in a number of other countries.

In that 21-year period between 1965 and 1986 the production of rice went from 233 million tons to 432 million tons among the 18 major rice producing countries of Asia. That was about an 84 percent increase in 21 years, and during that same time the population in those countries increased by only 59 percent, essentially a 60 percent rise in population. So for the first time in recent history per capita rice production went up.

However, the situation, as we will see in a few minutes, is getting to be different now because we are running out of some of the resources.

Mr. SCHEUER. We're running out of what, sir?

Dr. CHANDLER. Land resources for growing rice. India and China are the two world's largest producers of rice and also two of the world's most populous nations, and there has been no increase in the area devoted to rice in either of these countries since 1977, and actually China a little earlier than that.

So the increase has to be in using more fertilizer, irrigating more land, more multiple-cropping, using the best varieties that the plant breeders can develop, and there are going to be limits to all of these matters for growth.

We will hear later what biotechnology can do in the future, but we know that in some places we are reaching the theoretical limit, and I mean theoretical on a practical basis depending on environment, of the amount of food that can be grown on the land that is now devoted to agriculture. This is particularly true in Asia where so much of the world lives.

To me the high population growth rate is the most serious threat to the well-being of mankind. With a finite world and an infinite population, they just don't go together and we're going to commit suicide one way or another unless we can control our population in the long run.

I have just been to Bangladesh earlier this month and this is a good example of overpopulation. Bangladesh has an area of about 55,000 square miles, which essentially is the same as the States of Wisconsin or Georgia or Florida in the USA. They have 113 million people as compared to five or six million in these States, except Florida of course which has over 12 million now, the fourth most populated State in the Union.

Mr. **Scheuer**. Excuse me, as of the 1990 Census it will be the third most populated State Union. New York will fall to fourth. The four ranking States will be California, Texas, Florida and New York. Now I hate to say that because we'll be shipping some of our Congressional seats to Florida, Texas and California.

[Laughter.]

Dr. **Chandler**. Well, I used this just as an example. You see, the density of the population in Bangladesh is 2,028 per square mile, and I'm using U.S. units here, English units. Well, the density of population in New Jersey, which I believe is the most populated State from the standpoint of density, is about 985 people per square mile. You know, if you go from Newark to Jersey City and so forth, you've got lots of people there concentrated in a small State.

California is just about the size of, or it's not too far different from Japan, and again Japan has some 900 people per square mile, similar to New Jersey, all over the country. They are a prosperous country, but they are suffering greatly from overpopulation density.

I heard Peter Jennings say just a couple of nights ago broadcasting on ABC from Tokyo that all of the land in Japan, which is again roughly the size of California, is worth more than all the land in the United States of America. That's hard to believe, but apparently it's true. That's what he said anyway.

Well, the need for population control is great. I used in my written statement, which I filed with you, three examples of where human population is destroying natural resources or using natural resources faster than they can be maintained.

One of course is a country like Bangladesh that is way overpopulated already where over half the people are landless and where over half the people cannot get even 2,200 calories per day and a third of the population less than 1,800. You travel through Bangladesh and almost everybody looks thin. The get no more than two meals a day and so forth. They are depending on foreign aid and they are getting 2 million metric tons of rice and wheat that they are importing a year right now, and they are not able to keep up with the population growth rate, which is about 2.4 to 2.5 percent still, which means that they are doubling somewhere around every 30 years and it just can't go on. Death and destruction is going to take place before they can do that.

The only resource that they have that is abundant is water, and they get too much at times and too little at times, and their only hope for building this up is to increase their irrigation for a while.

I must get on. I know I've only got five or six minutes. So I'll just say two or three more things.

In my opinion, in these less developed countries the most important element that in the long run has to be improved is the degree of education of the people, and particularly of women. We are finding that the education and the employment of women is the greatest deterrent to increased birth rates. If they get busy and if they also understand what is going on and what people are doing, why they will limit their families. As you know, large families are insurance for old age.

Mr. SCHEUER. As you know, it's frequently said in the developing world that literacy is the greatest contraceptive. Literacy, the ability to hold a job and the ability to penetrate the world of work and support oneself and one's family off the land and off the bed. I think that point that you've made is terribly important.

Dr. CHANDLER. I agree, and there is considerable evidence to support this. If you look at the countries around the world and study their degree of literacy to population growth rate, you'll find there is a very inverse relationship there. The higher your degree of literacy, the lower the population growth rate.

We have seen this happen in South Korea and I guess North Korea, too, and Taiwan, Singapore, Japan, Egypt and China with a rather forceful program has gotten their birth rate down to about 1.2 percent now as compared to 3 percent not too many decades ago. This is something that is not easy to do and it can be very difficult.

I do think that one of the things that the U.S. can do is to intensify the work on birth control techniques. I think this is an important contribution that the developed world can make.

I read just the other day that only very few of the pharmaceutical companies are working on this now. They are cutting down to only about two of them in the country, and I think that's a shame because the current methods are not adequate for many of these countries. I think we should establish health clinics with family planning information, advice and materials to these people. And we here in America must also control our own population. I don't think we should ever get over 300 million in this country and we are now still increasing at the about the rate of 8/10ths of one percent a year.

Mr. SCHEUER. Would you repeat that?

Dr. CHANDLER. I said we are still increasing, the U.S., according to sources that I could get, we are still increasing at the rate of about 8/10ths of one percent a year, our population increase, and I would hope that we would not get beyond 300 million. We are now close to 250 million.

Mr. SCHEUER. Dr. Chandler, I would suggest that if you would include in that figure any reasonable estimate of illegal immigration of people crashing across our borders, it would be a great deal more than 8/10ths of one percent.

Dr. CHANDLER. I think this is supposed to be natural increase, and I believe the figure.

Mr. SCHEUER. Yes, from natural increase it's probably right, but if you added illegal immigration, which is two, three or four million, it would be at least another point. So you would be talking about 1.8 or 2 percent, and I think that is something that we have to be very concerned about.

I appreciate your testimony very much. As to this last point that you've raised as to the importance of educating women and giving women access to the world of work, we will have witnesses, we will have experts from Africa and Asia and Latin America who will be women leaders from those parts of the world who will be talking about just exactly that point. So you have raised the banner.

Dr. **CHANDLER**. May I add two other points that I just want to make, just statements?

Mr. **SCHEUER**. Certainly.

Dr. **CHANDLER**. One is that I feel that this slash and burn agriculture has to have a sustainable, and maybe we'll hear about that from Pedro Sanchez and others, but the slash and burn agriculture must be done away with and we must have sustainable agriculture, and I think the other big problem is the supply of fuel wood in semi-arid regions. I mentioned those in my written statement.

Mr. **SCHEUER**. I believe you did, right.

Dr. **CHANDLER**. Those are very important places where overpopulation and overuse is devastating the natural resources.

[The prepared statement of Dr. Chandler follows:]

STATEMENT OF ROBERT F. CHANDLER, JR. IN CONNECTION WITH THE HEARINGS OF THE SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURAL RESEARCH AND ENVIRONMENT OF THE COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY OF THE U. S. HOUSE OF REPRESENTATIVES, FEBRUARY 23, 1989, ON THE TOPIC OF THE FOOD-POPULATION BALANCE.

This statement will present a few facts and figures in an attempt to reveal both current progress and the major problems that face us on the food and population front.

I had the privilege of serving as the first director of the International Rice Research Institute (IRRI) in the Philippines, the organization that sparked the Green revolution in rice by creating new varieties for the tropics and subtropics that had a yield potential two to three times that of the traditional varieties. Because of my intimate contact with rice research and its production in many of the less-developed countries of the world, I place greater emphasis on rice, which is the staple food for nearly 2.5 billion people, 90 percent of whom live in Asia.

First, a few facts are given about the progress made in increasing the production of rice and wheat. Then the population problem is considered because, more than any other single factor, rapid population growth threatens the ability of the world to feed itself and to protect its life-sustaining resources. Finally, I give a few specific examples of countries or regions where the food-population (or resource-population) balance is so critical that immediate and drastic action is needed if catastrophic results are to be averted.

In 1965, just before the wide distribution of modern rice varieties with high yield potential, production in the 18 Asian countries that grow and consume most of the world's rice was 233 million metric tons. By 1986, 21 years later, that figure had jumped to 432 million tons, an increase of 84 percent. Eight of those countries had more than doubled their production.

Moreover, during the same period, the human population in the 18 countries had advanced from 1.7 to 2.7 billion, an increase of 59 percent. For the first time in modern history Asian per capita rice production had markedly increased. For decades, previously, harvests had either kept pace with population growth or had fallen behind.

The 84 percent increase in production in Asia was due more to augmented yields than to increases in area devoted to rice. The gain in yield was 60 percent, while the land area planted to rice expanded by only 14 percent. Moreover, since 1977 neither China nor India, the world's two largest rice-growing countries, has shown any increase in area planted to rice. This means that additional land suitable for rice is no longer available and that future gains in harvest will have to come from increased yields on land aready devoted to that crop.

In Africa, the situation is quite the opposite. During the 20-year period from 1965 to 1985, rice yields on that continent rose only from 1.68 to 1.80 metric tons per hectare, a gain of a mere 7 percent, whereas the land area planted to rice expanded by 60 percent. Although Africa produces only 10 million metric tons of rice annually (compared with over 430 million tons in Asia), rice is still the cereal grain that is growing the fastest in production - faster than sorghum, millet or maize, Africa's traditional cereal crops. Indeed, rice is so popular in most African countries that large quantities are imported to satisfy the demands of urban populations.

Even greater strides have been made with wheat. In the first five years after the semi-dwarf wheats were widely planted in India and Pakistan, for example, production was doubled. The Green revolution in wheat was sparked by Nobel laureate Dr. Norman Borlaug of CIMMYT, whose untiring efforts influenced many governments to realize the potentialities for greatly increasing the production of that crop.

As is widely recognized, the principal reason for the improved production of both rice and wheat was the revolutionary development of varieties that were short, stiff strawed, non-lodging, heavy tillering and fertilizer responsive and, in addition, had resistance to major insect pests and diseases. Furthermore, since the introduction of these new varieties, there has been a substantial increase in the use of chemical fertilizer and in the development of new irrigation systems. Moreover, in every country that was able to increase significantly its production of either rice or wheat the political leaders not only had gained an understanding of the importance of agricultural development but had become highly committed to an action program.

In fact, enough cereal grain is being produced to feed the world (at current inadequate levels of nutrition), but national and individual poverty and food distribution problems continue to cause about 500 million people to suffer from malnutrition. The situation, however, would be much more critical were it not for the creation and widespread adoption of modern varieties of rice and wheat.

Although, through increased food production, further progress will be made in alleviating the closely related scourges of hunger and poverty, there are limits to what can be done unless man is able to control his numbers.

The population problem, more than any other element, threatens the well-being of mankind. World population has passed the 5 billion mark. Each year adds more than 80 million people to the total, more than 60 million of whom will be living in Asia, Latin America and Africa, the regions least able to accommodate them.

The only good news on the population front is that since 1970 the population growth *rate* has been declining, a reversal of all previous trends since records have been kept. Other than in the prosperous, industrialized nations that have essentially stabilized their populations, the decreases have occurred mostly in Asia - primarily in China, Korea, Taiwan, Singapore, and recently in Thailand, Sri Lanka and Indonesia. China, with one-third of the inhabitants of Asia, has reduced its population growth rate to about 1.2 percent annually, an almost incredible acheivement. Offsetting that historic advance is the fact that, on the average, African populations are still growing at the rate of 2.8 percent and Latin America at 2.4 per cent.

United Nations experts predict that by the year 2000 the population growth rate will be reduced from the current 1.7 percent to 1.5 percent. However, because population expands exponentially rather than arithmetically, the number of people to be added in the year 2000 will be 92 million, in contrast to the 80-million addition in 1988. This forecast is based on the U.N. estimate that the earth will harbor 6.15 billion people at the end of the current century.

In 1945, the eminent demographer, Dr. Frank Notestein, propounded the theory that there are three stages of population growth as countries develop socially and economically. These demographic transition stages are as follows:

Stage 1. *High* birth rate and *high* death rate, during which populations increase very slowly. For example, between the years 1650 and 1700 world population grew only from 510 to 635 million, an average of but 230,000 per year.

Stage 2. *High* birth rate and *low* death rate, the stage that much of the Third World is in today. The control of malaria, yellow fever and polio, for example, and the improvement in nutrition have greatly increased human survival in the poorer countries; but birth rates remain high.

Stage 3. Low birth rate and low death rate, the final stage in the transition, the one that the U.S.A., Canada and western Europe are in today and the one that we would hope the entire globe would reach eventually.

The fear that population watchers have today is that many of the Third World countries will not be able to move out of Stage 2 (high birth and low death rates) into Stage 3 (low birth and death rates). They will be caught in what Lester Brown of the Worldwatch Institute calls the "demographic trap." Unable to achieve the social and economic gains that usually reduce birth rates, the population expands to the point where demand exceeds the sustainable yield of cropland, forests, grassland and even aquifers supplying fresh water. Finally, death rates rise again and conditions revert to Stage 1 (equally high birth and death rates) where life becomes intolerable, dominated by chronic hunger, frequent famine, and social conflict, even civil war. Indeed, it appears that some countries are reaching that stage already.

There are those who contend that population control is not important, that people are a resource and that to limit their numbers is to reduce the opportunities for human development. Others claim that that there is an ample supply of uncultivated land and other natural resources and all that is needed is their exploitation. It is difficult to understand how such a view of seemingly infinite reserves can long be held in this finite world.

There are limits to the available quantities of arable land, of fresh water supplies for irrigation, of areas that can be devoted to forests, and of food resources of the oceans. Furthermore, solar radiation and average world precipitation cannot be increased by man and

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despite the signal advances made in augmenting the yield potential of food crops, there are limits to the genetic improvement of both plants and animals.

I have been in Bangladesh this year at a workshop examining a comprehensive Agriculture Sector review in its final stages of completion. Because of my recent familiarity with the area, I shall use Bangladesh as an example of a country that is in a truly critical condition largely because over-population is putting a severe strain on its natural resources.

The population of Bangladesh is about 113 million and is still increasing at the rate of 2.5 percent annually. As an indication of the population pressure,consider that the country has an area of about 55,000 square miles, roughly that of Georgia, a state which contains about 6 million people.

The number of farm families in Bangladesh is about 15 million, though only 3 million own enough land to support a family(2.5 acres). The remainder are either landless or have to seek off-farm employment to survive. Such opportunities are insufficient to handle the large number of landless rural people. At least half the population is unable to grow or purchase enough food to consume 2200 calories a day and 30 percent has to exist on 1800 calories or less. Most of the rural, as well as urban, population is underweight and suffering from various degrees of malnutrition.

About 2.8 million people are being added to Bangladesh's population annually, the male labor force increasing by over one million each

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year. The participation of women in the labor force is not counted officially, but it is known through unofficial studies that many women work on the farms, or find work opportunities in small operations such as rice mills, brick yards, etc. It is clear that at least 1.2 million people are added to the work force yearly and that two-thirds of them will need to find employment in rural areas. The only way to create this employment in the near future is to increase agricultural output.

As a result of the Green Revolution there was a tendency for rice production in Bangladesh from 1966 through 1980 to more than keep pace with population growth. Since 1981, however, there has been a decrease in the growth rate of rice production without a corresponding decrease in population expansion. As a result, per capita rice production in 1986-87 was lower than it was in 1971.

The key to reversing this downward trend appears to lie in irrigating more land, using more fertilizer, developing better high-yielding rice varieties, and growing two crops of rice a year on as much land as possible.

At present, only 23 percent of the land area in the country is irrigated. It is estimated that this amount could be more than doubled. Much of the expansion in irrigated land would be in the dry season (for the boro rice crop) and in addition, supplemental irrigation should be provided during the rainy season for the so-called aus and aman crops. If the added irrigation, along with other inputs, is provided, the projection is that within the next two decades Bangladesh could increase its rough (unhulled) rice production from a current figure of 23 million metric tons to 42 million tons, an advance of about 83 percent.

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This is an attainable figure and would raise the average rice yield from the current 2 tons per hectare to 3.5 tons. To bring it higher than that would require considerable effort because Bangladesh is plagued by frequent floods and cyclones which cause heavy crop losses. Even this increase will not be possible unless funds are made available to expand the number of shallow and deep tubewells and other minor irrigation works and to insure that fertilizers and good seed are available to farmers at reasonable prices.

Another serious problem in over-populated Bangladesh is the scarcity of fuel in rural areas for cooking. Because firewood from trees is not available in most areas, crop residues and animal manure are burned for cooking rather than being incorporated into the soil to maintain organic matter content and the fertility of the soil. Even the stubble and roots are often removed and burned. The only renewable natural resource that the country has in abundance is water, and that frequently is either too much or too little.

Although Bangladesh may be considered an extreme case, it should serve as a warning to other countries as to what may happen if population growth continues unabated. India, for example, has done an impressive job of increasing its output of both rice and wheat and has been able to accumulate stockpiles against future needs. However, as mentioned earlier, the area devoted to rice culture has not increased since 1977 and it is clear that the reason is that all the land suitable for that crop is now being used. There are limits to what fertilizer, water and improved varieties can do to raise yields, and India must rely on increased off-farm employment and population control to maintain a healthy rural economy. Already, that country has resumed the importation of food grains.

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Although India has had a family planning program for over 30 years, its annual population growth rate is still nearly 2 percent. Unless this is reduced greatly, India's population will soon exceed that of China and, theoretically at least, would double in the next 35 years to over 1.6 billion. More likely, however, that figure would not be reached because of the exhaustion of many of the country's life-sustaining resources.

Another serious problem of special importance in the humid and sub-humid tropics of the less-developed countries is the prevalence of shifting cultivation (slash and burn agriculture), which is a prime destroyer of valuable forests. Equally negative and serious is the fact that those who attempt to eke out a living from this practice are locked in poverty because of extremely low crop yields. This is a time-honored method of land use, but as populations increase the so-called forest fallow period becomes increasingly short. In many areas today this period may be only two or three years in contrast to 10 or more years in the past, and soil fertility cannot be restored. It is imperative that sustainable farming systems be developed to replace the wasteful practice of shifting cultivation. Agroforestry will play its role by designing systems involving a combination of trees, crops and livestock in equilibrium with the natural resources of soil, water and tree cover. This is an important aspect of conservation, for it is estimated that even today over 250 million people practice slash-and-burn agriculture in their effort to survive.

Another area of major concern is the severe depletion of fuel wood in arid and semi-arid regions. In the Sahel of Africa, for example,

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It is estimated that firewood is being harvested at five times its growth rate. There is no easy solution to this problem, but one must be found. Planting of drought-resistant tree species such as Acacia albida and Prosopsis alba should be carried out, with protection during the early years from animal grazing and from harvesting by people. Obviously, village understanding and cooperation will be required as well as policing by authorized government agencies - quite a departure from current customs.

I have attempted in this relatively brief statement to portray the Green revolution in rice and wheat, especially in Asia, and to describe the dilemma that mankind faces as population continues to increase in this finite world. In addition, I have given three examples of specific situations where the human population is over-running the sustainable resources: overpopulated Bangladesh, the widespread practice of slash-and-burn agriculture, and the depletion of firewood in the semi-arid parts of the world.

Without question, in my opinion, the developed countries such as the United States, Canada, Australia and the nations of Western Europe, will more and more be supplying food grains to the less-developed countries. Furthermore, enormous amounts of foreign aid and resources of the developing countries themselves will have to be put into rural improvement. The essential actions clearly recognized by many authorities on development are as follows: make maximum use of available water for irrigation; improve and extend farm to market roads; build schools and strengthen institutions of higher education (including, especially, the education of women); create off-farm employment opportunities in rural areas; provide credit for qualifying

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farmers; establish crop-production incentives, such as price supports and subsidized inputs; improve the chain of communication from agricultural research to the extension specialist to the farmer; and distribute health clinics throughout the country that dispense family planning information and assistance.

It seems evident that before the human population becomes stabilized, it will at least double its current size. To support more than 10 billion people adequately will require a herculean effort, with an enormous commitment of financial and human resources, if we are to maintain this planet acceptably livable.

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Mr. **Scheuer**. Well, thank you very much, Robert Chandler.

Chris Shays, do you have a question?

Mr. **Shays**. Yes, I would like to ask a question.

Mr. **Scheuer**. By all means.

Mr. **Shays**. When my wife and I went in the Peace Corps we decided we could not go to India. I mean we just simply didn't think we could deal with it. It's hard for me to comprehend 2,000 people per acre or what did you say?

Dr. **Chandler**. 2,000 per square mile. That's in Bangladesh, which used to be India of course back before 1947.

Mr. **Shays**. The question I have is it seems to me clearly that as a Government we work at cross-purposes. Should we be tying some kind of, and maybe we do and you could tell me, significant strings to the food we provide these nations and so on?

The question I'm really addressing, sir, is the fact that we have short-run interests and we have long-run interests, and one of them clearly is we see people in need and we come to their aid, and it may be that all we do is exacerbate the problem and make it worse in the future.

Dr. **Chandler**. Self-sufficiency in food is a goal of many, many countries. In the case of Bangladesh it may be almost impossible for them to attain self- sufficiency, and we may have to have food aid if we are going to maintain the people and keep them alive. But, on the other hand, they have got to somehow reduce their population. If they don't do so by their own will and means, it's going to come about through just high infant death rates and so forth, just health conditions and malnutrition and the diseases that come from malnutrition.

Do you suggest that we cut off food aid and let them die before they can get things under control?

Mr. **Shays**. I didn't suggest that.

Dr. **Chandler**. I know you didn't suggest it, but I mean you asked the question, did you not?

Mr. **Shays**. Yes, I asked the question.

Dr. **Chandler**. I would say from a humanitarian point I don't think we can do this at the moment.

Mr. **Shays**. The question is what type of humanity is that? In other words, what does that lead to? What does the policy in the short run that we provide food and are not in some way trying to create a long-term change in direction?

Dr. **Chandler**. There is no easy answer to that, but I feel this way, that to the extent possible we should help them to increase their own production to the fullest extent possible.

While I was in Bangladesh I was asked to make an estimate of the rice production, and rice is their most important staple food, an estimate for their potential for increasing rice, and I said that if, after studying it and looking at their present figures and the amount of land under irrigation and so forth, that if they could get the inputs, if they can more than double their land area irrigated and could continue to use more fertilizer and to multiple-crop as much as possible, to grow at least two rice crops on most of the land that is suitable for growing rice, that they could have an 84 percent increase over their present current level, but it might take them 20 years to do this at the rate they're going.

Mr. **Scheuer**. Would that be an environmentally sustainable level of food production that wouldn't damage the environment?

Dr. **Chandler**. It would be environmentally sustainable.

Mr. **Shays**. I had one last question.

Mr. **Scheuer**. Chris, I would like to footnote something you said, and I will yield to you when I'm finished. I would like to expand on the point that Chris has raised.

He is saying we are giving them food to enable them to live, and in the long run doesn't that create more human misery. He is asking the question might that not create more human misery and tragedy and starvation and disease, than if we had let nature take its course and let nature act as an equilibrium generator itself at a much lower level of population.

I want to add to what he said, because we are intervening and what are the moral consequences of our intervention? We intervene to provide food that keeps a lot more people alive at very marginal levels of existence, hardly at a quality of life that we would deem attractive.

We not only provide them food, but we intervene to provide them, and you say if they don't limit population, then they will have death, disease, famine and what-not. Not true. The Rockefellers, and I don't want to make a partisan thing about this, but the Rockefellers are responsible for this problem, right, Chris?

Mr. **Shays**. I'm not going to say—

Mr. **Scheuer**. Sure they are.

Dr. **Chandler**. I worked for the Rockefeller Foundation for 20 years. Go ahead.

Mr. **Scheuer**. Exactly. It was the Rockefeller Foundation that developed the science of public health in the last quarter of the last century. Now we didn't get it out to them all that fast. It was mostly enjoyed and used in the developed world, but after World War II we engaged in what I think and what Chris might think was a course of conduct that raises a lot of moral questions because we not only started providing food to the developing world, but we provided them with knowledge about sanitation, clean water, injections for preventable diseases and cures for intestinal diseases. So we radically reduced the death rate, we radically reduced infant mortality, we radically reduced maternal mortality and we radically increased survival rates of birth to five years old by giving them food and all of these other so-called advances of the developed world that the Rockefellers really in their generosity and moral leadership developed.

But what did that do? That produced the demographic transition. That produced much lower rates of mortality, but the Rockefellers and the rest of us forgot to teach them that if we didn't want absolutely uncontrollable population increases with the reduction in mortality, we had better teach them about how to achieve a reductions in fertility, too, because over the centuries nature managed that, as you point out. Over the centuries we never had a population growth rate up until the last couple of hundred years of more than one percent per century, not per annum, per century, because nature provided that equilibrium that you're discussing, famine, plague, pestilence, war. Nature did it.

So over the eons of time mankind survived with high rates of fertility and high rates of mortality. Now we have interrupted that equilibrium that nature created and we have radically reduced mortality, but without doing anything about fertility.

And you can say the United States has assumed enormous moral culpability now by continuing food aid and by continuing preventive health aid, but cutting off population aid, by crippling the UNFPA, the United Nations Fund For Population Activity, cutting our contribution to them, crippling the IPPF, the International Planned Parenthood Federation in its ability to serve 130 or 140 affiliated agencies around the world with this absurd philosophy that if they use their own monies, their own national monies and their own privately raised monies to counsel on abortion or to finance abortion, we will refuse to give them assistance on their other population activities.

So we have a real moral culpability here by intervening to lessen mortality, both by providing food and medical technology, but withdrawing our assistance in reducing fertility. So we are encouraging what we call this demographic transition, which is where you have continued high fertility but reduced mortality, and that gray area that you could fill in is what gives us these explosive population rates, all of which have happened in the last generation. Pre-World War II there was nothing like that. It took us a million years to achieve a billion population. We achieved that about 1830. It too us another hundred years to achieve the second billion in about 1930, and then it started after World War II, about 30 years to achieve the third billion in 1960, and then it was 17 years for the fourth billion and 12 years for the fifth billion, and that's where we are now.

Our intervention has fueled that population explosion and how are we going to stop it? I think Chris Shays raised a very valid point, that once having intervened to provide food and to provide health care that radically reduced mortality, we have a moral imperative to do something very real and very significant about this demographic transition, the difference between those lines of high fertility and reduced mortality. That is what constitutes the population explosion, and I think that he put his finger on a very key moral issue facing our country.

What are going to do about this demographic transition that we ourselves have created?

Chris, I congratulate you for raising that.

Dr. CHANDLER. Well, I'm not disagreeing with that at all, but I don't think it would be right to suddenly next year to cut out all food aid around the world. I think that's going back to the first stage of this demographic transition.

Mr. SCHEUER. I don't think Chris Shays was recommending that. He was posing a moral question of how do we intervene? Now we have intervened to reduce mortality by providing food aid and health aid and health prevention aid of many kinds, and that has produced a population explosion. Don't we have some obligation to help these nations achieve equilibrium of food and people, and there is only one way to do it without cutting off food and medicine and health care and preventive inoculations and that is to help them to get their fertility rates down. I think this is the moral imperative facing us.

Dr. CHANDLER. I think so, too, and I don't think we ought to dictate to the other countries how they do it. We limited, or Mr. Reagan when he was President limited our foreign aid to some countries because they were using family planning methods that he didn't approve of, of course meaning abortion. I don't think we should tell them how to do it. I think that we should help them to do it. Now that's a personal opinion, and I'm not a politician.

Mr. SCHEUER. On that high note, why don't we finish with your testimony. We have been much too long with you, and that's an indication of how interesting and stimulating it was.

Mr. SHAYS. I just have one question.

Mr. SCHEUER. Yes, by all means.

Mr. SHAYS. You made one comment, and I just want to make sure I heard you correctly. You gave me the feeling that we have reached the limit of what we can get per acre of yield of any particular—

Dr. CHANDLER. We haven't yet reached a limit, but it has slowed down, and I should have made that clear.

Mr. SHAYS. But theoretically there is a time, for instance, in energy that energy prices could drop down significantly with solar energy and so on and other sources. Is there a theoretical limit to what we can yield with rice or wheat per acre?

Dr. CHANDLER. Yes, there is a theoretical limit. You see, before the Green revolution most of the rice yields in tropical and subtropical Asia were somewhere around 1.2 to 1.7 metric tons per hectare and with the best management you could get in those days with these tall, droopy leaved varieties that fell over and lodged, you could get up to 2.5 and sometimes 3 metric tons per hectare. That was as high as you could get.

With these new varieties of stiff strong upright leaves, heavy tillering varieties, you can go between 5 and 10 metric tons under ideal conditions. Under good conditions farmers can get as much as 5 metric tons per hectare, but with weather conditions and disease and insect attack and so forth, they have generally been lower than that but they, as I mentioned earlier, have been—well, eight of those Asian countries doubled their yields, or more than doubled their yields in the 20- year period, but they won't double their yields again probably, but they will go up some more. It will keep going. Like the law of diminishing returns, you will gradually get less and less.

What biotechnology can do, I don't know. It probably will stabilize yields at a fairly high level by helping to get varieties that are resistant to insect and disease attack and adverse soil conditions and so forth, but how far we can go, we don't know. But you can go farther.

Yields are so low in Africa and there is still land available there, that we can go quite a bit more in Africa than we have at the present time without any question. Asia is the place where you're going to have the greatest limitation in land resources I believe.

Mr. SCHEUER. The greatest limitation?

Dr. **Chandler**. Yes, because of the overpopulation now and the use of their arable lands. So much of their arable land is now being cultivated in Asia.

Mr. **Scheuer**. It's virtually all being cultivated and there is no way to expand it really.

Dr. **Chandler**. You can only increase yields. You can get more irrigation and you can get some more multiple cropping and so forth.

Mr. **Scheuer**. I take it from what you're saying, Dr. Chandler, that the Green revolution which spurred this incredible surge of production, this increase in food production during the 70's has now sort of played itself out.

Dr. **Chandler**. It's beginning to show signs of diminishing.

Mr. **Scheuer**. It's beginning to show signs of that, and I take it there are really no new packages of high yielding technologies that are being developed or are at the point of being exploited?

Dr. **Chandler**. In yield potential, there is no variety that has been created by the International Rice Institute or by any national program that has outyielded IR-8, which is the first variety that we had. Now we have had better ones for grain quality and better ones for insect and disease resistance and so forth, but for potential yield, there is nothing that has exceeded it. Pedro Sanchez was out there with us and he will tell you the same thing.

Mr. **Scheuer**. What is the potential let's say in India and the Philippines of continued significant increases of food production as a result of the Green revolution there? Is it more or less tapering off and more or less hit a bench line?

Dr. **Chandler**. The Philippines should be able to do somewhat better than it has, but it has doubled its rice production in the last 20 years. I think it probably will go up another 50 percent. It's hard to say, you know, because they get typhoons. They've got more typhoons there than any other country in the world and they get various things that cut down crop yield, and they have got overpopulation problems, too, very serious.

Mr. **Scheuer**. Can you think of anything that could be done apart from the Green revolution in which you have been not only a participant, but one of the intellectual creators, to increase the capacity of developing countries, especially in Africa where there is very little available capital to make the big investments in agricultural research that you were able to lead in the Philippines? What is the prospect for agricultural research to produce some real food breakthroughs that would be appropriate for the small-scale farmer in Africa with a whole subset of climate and land conditions that differ from Asia?

Dr. **Chandler**. Africa of course has more problems than Asia or it would have progressed farther than it has. It has problems of illiteracy. Only 10 percent of the people are literate in Mali, Burkina Faso, Senegal and so forth. So it's very difficult to get programs for rural development and programs of family planning going into illiterate societies.

You've got another problem that the soils of central Africa are covered with a granitic cap. Soils are developed from granite. The soils that are developed are old, they have low moisture holding capacity and are relatively sandy and they have low ability to hold nutrients, or the cation exchange capacity as soil scientists call it, and they are very erodible when cleared of vegetation. They don't have those broad flood plains that you have in Asia where you can grow rice abundantly and it's very difficult. Of course, there are other crops that you can grow on the hills, but you have to be careful you don't erode your soils.

Agroforestry to me has a very real potential in Africa. There are some humid parts of Africa where you can grow a combination of trees and food crops as well as a certain amount of animals. That is something that has to be developed and we need much more research on that.

There is no question but what agricultural research can have its impact. One of the real problems in Africa is that the national programs have not been able to put in the resources they need to maintain their research programs.

I have been in many African countries consulting in the last 15 years, and oftentimes you'll find that people have been sent by U.S.A.I.D. to America and elsewhere to get their master's and Ph.D. degrees and get them back there and they have no operating funds and they just sit there drawing their salaries. They pay their salaries for political reasons, but they don't give them anything to work with. Liberia is an awfully good example of this and you see it in Sierra Leone and you see it in Ghana, all those countries in West Africa where they grow some rice and where I've been I have seen this many, many times.

So support for the program itself, training of people, education of people and doing research on the ground where the problems are and not getting something and try to transport it from here over to there. Those are some of the things you can do, but it's not easy.

Mr. **Scheuer**. In other words, don't do that agricultural research at some of our great land grant colleges where they do great agricultural research appropriate for our country, but do it there.

Dr. **Chandler**. That's right, and that has been shown so many times and we all recognize that.

Mr. **Scheuer**. Congressman Shays?

Mr. **Shays**. No questions. Thank you very much.

Mr. **Scheuer**. Well, Dr. Chandler, you've been a wonderful witness and you are a global prize winner and a global resource. We thank you very much for being here. We may have some questions for you later.

Dr. Hillel Gordin is Director of the National Mariculture Institute in Eilat, Israel. He received his graduate training in California at the Scripps Institute of Technology that this Subcommittee has visited on several occasions.

He has pioneered the development of commercial fish farming in Israel and is now working in close collaborations with the Egyptians, with top-ranking Egyptian scientists to help them join Israel as major- scale fish farmers.

We are delighted to have you here, Dr. Gordin. I might say that this Subcommittee visited Dr. Gordin only a few months ago in Eilat. We met with him and several of his Israeli colleagues along with about a baker's dozen top-ranking Egyptian scholars in the field of agriculture and mariculture, and we observed at first hand the really terrific and forthcoming collaboration and cooperation between Egyptian and Israeli scientists who joined together in meeting this great moral challenge of increasing Egypt's food production capability.

So we are delighted to thank you for the past education that you have afforded this Subcommittee, your past many, many acts of friendship and courtesy and your professional collegiality. We welcome you here today and we look forward to your testimony.

As I mentioned before, your prepared testimony will be printed in full in the record. Please take your five or six minutes and than I'm sure we will have some questions for you.

STATEMENT OF DR. HILLEL GORDIN, DIRECTOR, NATIONAL CENTER FOR MARICULTURE, ISRAEL OCEANOGRAPHIC AND LIMNOLOGICAL RESEARCH INSTITUTE, EILAT, ISRAEL

Dr. GORDIN. Thank you, Mr. Chairman and Members of the Committee.

First, allow me to express my thanks and appreciation for inviting me to take part in this hearing. The subject of the hearing, "human population- food production" is of great importance to our planet. My colleagues and myself feel very honored and moved that you consider our work in Eilat in the field of mariculture important enough to call for my participation in this hearing.

Since the time allocated for individual presentations is short, I will try and emphasize only the most important issues that stand out in my mind as vital factors for the development of aquaculture and progressing it to a level comparable to agriculture as we know it today.

I shall address myself only to the marine domain since I am strongly convinced that on a global scale, fresh water is too scarce and too expensive to justify an expansion of its use for aquaculture.

To demonstrate and support this point, I want to draw your attention to the work done by Staff and Stoll, CSIS, in December 1987 titled "U.S. Foreign Policy on Water Resources in the Middle East." In a thorough analysis they point out that "By the year 2000, water- not oil- will be the dominant resource issue of the Middle East." And "despite modern technology and feats of engineering, a secure water future for much of the world remains elusive."

The Middle East is just an example of the worldwide problem, and for this reason I believe that any major development in the field of aquaculture should and will be based on seawater.

For ages seafood has been done, the production of seafood was done mainly by fishing, and fishing, one has to understand, is basically hunting in water. During the last decade global fisheries landing has been fluctuating between 65 to 85 million metric tons annually. The figure of 1986 that is brought up in the FAO statistics of Fisheries Yearbook was 91 million metric tons. Of that aquaculture production was 9 percent in '75, 13.5 percent in '83 and about 15 percent in '86, which is an estimation of course.

Time and conditions are ripe to increase effort towards the direction of moving from fishing, hunting and gathering to culturing. Mankind must repeat its terrestrial farming evolution once more, this time in the marine domain. Culturing marine organisms on a major scale will compensate the limited fisheries catches and landings, while providing an innovative way of food production, food of relatively high quality.

The technological progress made in culturing marine organisms during the last decade is significant, but far from satisfying. On a global scale, especially in the Western World, too many mistakes were done in trying to implement and practice marine farming.

The anxiety to achieve fast success caused many to overlook missing biotechnological basic details. The scientific backing was scarce and many times not very professional. Frequently scientists were too far away from the sites of the projects, thus not experiencing personally the evolving problems.

Moreover, I am truly convinced that the scientific treatment of mariculture, was led by wishful thinking and by the short-lived enthusiasm of the entrepreneurs rather than by rational, disciplined biological analysis.

I believe, nevertheless, that by applying the right long-term approach and thoroughness to the development of mariculture it will soon become a major producer of high- quality food, plants and animals.

Now the policymakers must recognize the fact that in order to advance mariculture into a sound and predictable industry, research and development has to get the highest priority in the field.

When a fish species is chosen as a candidate for culturing, for example, its basic biology must be thoroughly studied, thus well understood to the level in which farming manipulation can be applied. It should be known as well as a chicken is known to science. Reproduction control, larval rearing, nutritional requirements, disease control and grow-out techniques to mention just a few of the scientific fields that must participate in the R&D process.

Another principle which I find is a very important one is by the process of domestication of wild species, fish, crustacean or algae, the process of research must be carried out under one roof and under one committed leadership in order to achieve the targets and the goals that one sets.

The ability and potential of marine organisms to grow under farming conditions is amazing. Algae has been shown to grow at a rate of 15 to 20 grams of dry matter per square meter per day. In comparison we can talk about rice or sorghum or sugar cane which are know to be very productive plants and reach this goal at the same rate.

Recently in our Eilat facility we have cultivated the macroalgae Ulva for an extended period of time, harvesting on the average 30 grams of dry matter per meter square per day, which if translated into hectare yields, we are talking about 100 tons per year per hectare.

Fish are grown in floating pens or in ponds at high densities and in high yields. We are reducing food conversion coefficients down to the minimum, the theoretical minimum.

Still a very large portion of the food fed to the fish, oysters, shrimps and other organisms under cultivation will be excreted into the medium in which they grow. Eventually these excretory products will end up polluting the environment.

We should be very careful and develop the technologies to protect the water quality before it returns to the sea. We must strip the effluent of mariculture operation from all chemicals, organic and inorganic.

In Eilat we are developing the technology for cleaning the outgoing water by using the above-mentioned Ulva as a nutrient stripper. We do it because we want to maintain the water quality of our source, the sea, as high as possible. Severe water quality deterioration resulting from mariculture activity has occurred in many places, forcing the farmers either to abandon the operation or reduce the level of production.

I believe that the most significant contribution I can make today here is pointing out the tremendous potential mariculture holds for desert lands which border the sea. There are many thousands of miles of shoreline around Africa, Asia, Mexico and South America and of course Australia which are harsh deserts. Land is non- tillable and fresh water is very scarce to support any meaningful food production.

On the other hand, developing mariculture in the tropic and subtropic coastal deserts is an idea which can be realized thus giving people living there a new means of livelihood. The majority of these regions, especially in Africa, are poverty stricken and the local population is continuously on the verge of hunger.

I believe that mariculture has the potential to alleviate the human conditions in many such areas. We have proven that mariculture in the desert is more than a dream. It can be realized.

Now the farming techniques must be designed to suit the target human population. The level of technological skill and education must be taken into account and social structure and behavior should not be overlooked. Basically the technology at the beginning must be simple, requiring a low rate of investment, low energy demands, but be labor intensive.

I sincerely believe that such a dream can be realized if the world community will devote some effort towards it.

Thank you.

[The prepared statement of Dr. Gordin follows:]

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ISRAEL OCEANOGRAPHIC & LIMNOLOGICAL RESEARCH Ltd.
National Center for Mariculture
P.O. Box 1212, Elat 88 112
Tel. 059 - 71280, 74952, 74347 טלפון, FAX 059 - 71796, Ext. 2053

חקר ימים ואגמים לישראל בע״מ
המרכז הלאומי לחקלאות ימית
תא דואר 1212, אילת 88 112
Telex 7792 ARDOM IL טלקס

TESTIMONY OF
HILLEL GORDIN, DIRECTOR OF
THE NATIONAL CENTER FOR MARICULTURE, EILAT
ISRAEL OCEANOGRAPHIC AND LIMNOLOGICAL RESEARCH INSTITUTE

AT HEARINGS CONDUCTED BY
THE COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
ON THURSDAY, FEBRUARY 23, 1989

Mr. Chairman, Members of the Committee !

First, allow me to express my thanks and appreciation for inviting me to take part in this hearings. The subject of the hearing "human population - food production" is of great importance to our planet. My colleagues and myself feel very honored and moved that you consider our work in Eilat, in the field of mariculture, important enough to call for my participation in this hearing.

The time allocated for the individual presentation is short. Therefore, I will try to emphasize the most important issues that stand out, in my mind, as vital factors for the development of aquaculture, and progressing it to a level comparable to agriculture as we know it today.

I shall address myself only to the marine domain since I am

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strongly convinced that, on a global scale, fresh water is too scarce and too expensive to justify an expansion of its use for aquaculture. To demonstrate and support this point, I want to draw your attention to the work done by Joyce R. Starr and Daniel C. Stoll, CSIS, Dec. 1987, titled "U.S. Foreign Policy on Water Resources in the Middle East". In a thorough analysis they point out that "By the year 2000, water - not oil - will be the dominant resource issue of the Middle East". And "despite modern technology and feats of engineering, a secure water future for much of the world remains elusive". The Middle East is just an example of a world wide problem. For this reason I believe that any major development in the field of aquaculture should and will be based on sea water.

For ages, acquiring seafood has been done mainly by fishing. Fishing is basically hunting in water. During the last decade, global fisheries landing has been fluctuating between 65 to 85 million metric tons (mmt) annually. In 1986 the figure, according to FAO statistics (FAO Yearbook, Fisheries Statistics. Vol. 62, 1986) was 91 mmt.. Aquaculture production made about 9% in 1975, (Gordin, 1982) to 13.5% in 1983 (compiled from FAO statistics and a paper by C. Idyll 1988) to around 15% in 1986 (estimation).

One should understand that fishing has its limitation. The fish populations in the oceans are of finite size. Man can tax them (fish), only at a levy smaller or equal to their natural rate of recruitment. Failing to recognize this basic and simple principle, Man has been damaging recently, valuable living resources in the marine environment. Moreover, Man inflicts on the environment insults of such a magnitude (pollution, major engineering changes - like the Aswan Dam) that has very negative effects on the marine living assets in the disturbed region. The need for innovative strategies, aimed and designed to ease and correct the chaotic situation, is an urgent prerequisite for saving our planet's oceans from further deterioration. However, this subject is beyond the scope of the present hearing.

Time and conditions are ripe to increase effort towards the direction of moving from fishing, hunting and gathering to culturing. Mankind must repeat its terrestrial farming evolution once more, this time in the marine domain. Culturing marine organisms on a major scale will compensate the limited fisheries catches and landings, while providing an innovative way of food production, food of relatively high and quality.

In practicing mariculture we turn sea water into a means of food production in a controlled way. The level of control is determined by the degree of know-how, the available technology and the rate of investment. In mariculture, we recognize, as we do in aquaculture or in agriculture, two ends on a scale regarding the degree of controlling the farming operation: 1. Extensive farming: characterized by high degree of dependency on mother nature, little manipulation of the environment and the cultured organisms by the farmer, and minor investments - all leading to low yields per units area and time. 2. Intensive farming: characterized by high technological level based on scientific knowledge, high degree of manipulating of the farmed organisms and their environment, high level of capital investment - thus, resulting in high yields per units area and time. Needless to say, one finds all possible intermediate levels between the above two ends.

Mariculture is practiced in many countries and under a very wide range of ecological conditions. To mention just few - tidal flats and pools in south east Asia, fjords in Norway and Scotland, Seto Sea in Japan and shallow sea bottom off the eastern coast of the United states. The main groups of organisms farmed in seawater are finfish, molluscs, seaweeds and crustaceans.

The technological progress made in culturing marine organisms during the last decade is significant, but far from satisfying. On a global scale, especially in the Western World, too many mistakes were done in trying to implement and practice marine farming. The anxiety to achieve fast success caused many to overlook missing bio-technological basic details. The scientific backing was scarce, many times not very professional. Frequently, scientists were too far away from the sites of the projects, thus, not experiencing evolving problems. Moreover, I am truly convinced that the scientific treatment of mariculture was lead by wishful thinking and by the short lived enthusiasm of the entrepreneurs, rather than by rational, disciplined biological analysis. I believe, nevertheless, that by applying the right, long term approach and thoroughness to the development of mariculture it will soon become a major producer of high quality food - plants (algae) and animals.

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The policy makers must recognize the fact that in order to advance mariculture into a sound and predictable industry, R&D has to get the highest priority. When a fish species is chosen as a candidate for culturing, its basic biology must thoroughly studied, thus well understood to the level in which farming manipulation can be applied. It should be known as well as a chicken is known to science. Reproduction control, larval rearing, nutritional requirements, disease control and grow-out techniques to mention just a few of the scientific fields that must participate in the R&D process. Another principle by which the domestication of a wild species (fish, crustacean or algae) must be carried out, is to have all the above mentioned scientific disciplines working under one roof and under one committed leadership (which preferably will be made by more than one person). If so done, success is just a matter of talent, budget and time.

The ability and potential of marine organisms to grow under farming conditions is amazing. Algae has been shown to grow at a rate of 15 to 20 grams of dry matter per square meter per day. In comparison let us look at few terrestrial examples: sugar cane has a rate of 18.4, rice 8.0 and wheat 8.3 (Lapoint, 1976). Recently, in our Eilat facility we have cultivated the macroalgae Ulva sp. for an extended duration (8 months), harvesting 30 gr. of dry matter per meter square per day.(such a rate amounts to an annual crop of dry organic matter of over 100 metric tons per hectare). Fish are grown in floating pens out at sea or in fjords at densities ranging from 50 to 250 fish per cubic meter of water making a biomass of 50 to 80 kg. Intensive ponds yield 50 to 100 tons of high quality fish per year per hectare. Food conversion coefficient in some cases are as low as 1:1.5.

Still, a very large portion of the food fed to the fish, oysters, shrimps and other organisms under cultivation, will be excreted into the medium in which they grow. Eventually these excretory products will end up polluting the environment. We should be very careful and develop the technologies to protect the water quality before it returns to the sea. We must strip the effluent of mariculture operation from all chemicals (inorganic and organic compounds). In Eilat we are developing the technology for cleaning the out-going water by using the above mentioned Ulva as a nutrient stripper. We do it because we want to maintain the water quality of our source (the sea) as high as possible. Severe water quality deterioration resulting from mariculture activity has occurred in many places, forcing the farmers to abundant their sites or reduce the level of operation.

I believe that the most significant contribution I can make here is pointing out the tremendous potential mariculture holds for desert lands which border the sea. There are many thousands of miles of shore line around Africa, Asia, Mexico and South America not to mention Australia which are harsh deserts. Land is non tillable and fresh water is very scarce to support any meaningful food production. On the other hand, developing mariculture in the tropic and subtropic coastal deserts is an idea which can be realized, thus giving the people living there a new means of livelihood. The majority of these regions, specially in Africa, are poverty stricken, the local population is continuously on the verge of hunger. I believe that mariculture has the potential to alleviate the human conditions in many such areas. We have proven that mariculture in the desert is more than an idea.

The farming techniques must be designed to suit the target human population. Level of technological skill and education must be taken into account. Social structure and behavior should not be over looked. Basically, the technology at the beginning, must be simple, requiring low rate of investment, low energy demands but labor intensive. I sincerely believe that such a dream can be realized if the world community will devote some effort towards it.

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Attached is the following bibliography:

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Mr. **Scheuer**. Thank you very much, Dr. Gordin.

Incidentally, we have been joined by Congressman Bob Walker of Pennsylvania, who is the Ranking Republican on the Science, Space, and Technology Committee. Bob, we are very happy to have you with us. Do either of my Republican colleagues wish to start the questioning?

Mr. **Walker**. Thank you, Mr. Chairman. I'm sorry I just got in. I was over in another hearing.

Just as an analysis from all of you, do we have sufficient food in the world today to feed the world?

Dr. **Chandler**. Yes, there is sufficient food in the world to maintain the population at present standards of nutrition, which are inadequate. There are over 500 million people suffering from malnutrition in the world today, but they could be improved somewhat if all of the food that is being grown or could be grown in the developed countries like Europe, Canada, the U.S., Western Europe, Australia and so forth could be distributed.

Mr. **Walker**. Yes. I was going to say we have a distribution problem.

Dr. **Chandler**. Well, it costs money. It seems to me that national poverty and individual poverty are the big things that prevent it from getting to the country, and then you have distribution problems from within the country, and you also have all sorts of other things, but there is enough food today.

We estimate that if the world population is doubled to 10 billion people that we still could produce enough food to feel them, although we would have to give up a lot and we would have to put in a tremendous amount of investment. It's going to take a huge, enormous amount of funds, of money, both national and international funds to make that possible and still have this as a suitable place to live.

Mr. **Walker**. I want to get the parameters, though, of what we are dealing with here. To some extent I mean we are dealing with technological problems and we're dealing with scientific problems, but to a large extent in the world today we are dealing with distribution problems, we are dealing with wealth problems and in fact we are dealing with political problems. Isn't that largely the case?

Dr. **Chandler**. Yes, of course, all of those.

Mr. **Walker**. In some places where we have seen significant malnutrition and significant starvation even, it has been largely as a result of political decision- making rather than the unavailability of food.

Mr. **Scheuer**. Will my colleague yield, and than I will yield back?

Mr. **Walker**. I will be glad to yield, sure.

Mr. **Scheuer**. Isn't the implication of what Congressman Walker is saying the old adage of pay now or pay later? If we don't pay now to help the developing world get a handle on its exponential rates of population growth, then when the global population achieves this 10 billion level you suggested that we're scheduled to achieve about the year 2010, then somebody is going to be called upon to make these enormous capital investments that you just described to feed 10 billion people rather than the 5.4 billion that we have now.

And when there is a moral demand for enormous capital inputs, they are not going to be looking at Pakistan and Bangladesh. People are going to be looking at us.

Mr. **Walker**. But I would say to you, Mr. Mr., I'm not certain that my point was that Malthusian.

Mr. **Scheuer**. I'm talking about the implications of your point.

Mr. **Walker**. I understand, but what I'm trying to get at here is we may well have some problems that we have to solve, but one of the things we've got to do is understand the implications of the problem that we're dealing with, and that is that we are dealing with a distribution problem. That's partially involved with the wealth. But we are also dealing with a political problem in that some of these countries have in fact in some cases actually promoted starvation as a political weapon.

Secondly, we have had a situation where the types of economies that they have imposed for political reasons on their peoples, and structured, controlled economies have in fact led to some of their food problems within; isn't that correct?

Dr. **Chandler**. It depends on which country you want to pick out, that is also a factor.

Mr. **Scheuer**. Well, you can look at the socialist economies of sub-Saharan Africa whose economies are an absolute basket case and whose farmers engage in subsistence farming for themselves because the country has set food prices, because they are catering to their urban masses, because that's where the revolution comes from, not from rural masses, they set food prices so bloody low that it doesn't pay a farmer to raise food for sale. So the farmer raises food for himself, and then that country has to come to the United States.

I think Congressman Walker has hit on a very key issue here. A large part of the inability of the developing world countries, especially in sub-Saharan Africa, comes from the the fact that their socialist economics have proven to be basket cases and don't provide the economic incentives for their farmers to save money. So then the countries apply to us for PL-480 funds.

We have an American economist living in Mexico City by the name of Borloug. What's his first name?

Dr. **Chandler**. Norman Borloug.

Mr. **Scheuer**. Norman Borloug, and he says one of the key causes of starvation in the Third World is our PL- 480 program because that means that these socialist economies don't have to set food prices at a level that is economic which provides an incentive for their own farmers to raise food. So they cater to their urban masses by setting very low food prices, their farmers don't raise it and so they come to Uncle Sam and PL-480 is there and we export the food and this is a continuing capital gain on us resulting in a major extent to these totally moribund socialist economies that they have encumbered themselves with.

Every day they continue with those economies, they are shooting themselves in the foot, and the only countries in sub-Saharan Africa who have emerged from that morass are countries that have shucked off that socialist economy.

I suggest to you that Zimbabwe is a perfect example. Their Chief of State, Robert Mugabe comes to international conferences and takes the Maoist line and harangues against the United States, but there at home they have a very dandy mixed economy. They have one of the most brilliant Finance Ministers in the world, what's his name, Bernard Chidzaru, who absolutely has a hands- off policy on the economy. They provide financial incentives, their farmers raise money for profit and they don't need PL-480 funds. Excuse me, I want to apologize for interrupting you.

Mr. **Walker**. That's okay. I couldn't have said it better myself. But the question was we are not likely to solve food problems with technological solutions or with scientific solutions if we don't solve the political problems first, are we?

Dr. **Chandler**. It's true there are political problems to solve and they have to come first, no question about it, but at the same time there are potentials for technology to play its role, too, and it's going to come.

Now Zimbabwe, which I was there when it was Southern Rhodesia way back, and they have abundant land resources, and they have a lot of European farmers in there. There are some things that are different in Zimbabwe than they are in Liberia.

Mr. **Scheuer**. And let me tell you, Dr. Chandler, that I helped organize the first African Conference on Family Planning in the spring of 1986, in May of '86 in Zimbabwe. I played a back-stage role. It was all headed up by African parliamentarians, and it was a nifty conference. Robert Mugabe gave a first-rate speech in support of family planning, and Bernard Chidzaru, their Finance Minister said if we don't get our population explosion under control, this economy is going to be dead. The head of the African Development Bank, Abu Diaf, gave a great speech on family planning.

Anyway, the point I want to make is that at that time in May of 1986 European farmers who left Rhodesia to go to South Africa at the time of independence were coming back in large numbers. Why? Because they had heard from their colleagues, the European farmers who had stayed, that they are doing great, and they are raising food, they are making money, they have a nifty little free private enterprise economy that provides proper incentives.

So the European farmers who had fled from Rhodesia to South Africa at the time of independence in 1980 were coming back, and what better testament could you have to the fact that Robert Mugabe talks a great Maoist line at the General Assembly in New York, but his Finance Minister, Bernard Chidzaru runs a dandy little mixed economy with ample financial incentives to turn on not only small-scale individual farmers, but large-scale agri- business farmers to go in there and to raise a lot of food and sell on the market that provides a perfectly good financial incentive.

Mr. **Walker**. They still have the problem there of shooting tribesmen that don't agree with them.

Mr. **Scheuer**. Well, even that has moderated because the leader of the opposition, the chap who, and I forget his name, who Mugabe had sort of driven out, he was wandering around the conference room in his ceremonial robes being perfectly happy and not being harassed. So even that is moderating somewhat, but they have made major strides in getting their economy into working order.

Mr. Walker. I agree. I think the Ivory Coast has done even better.

Mr. Scheuer. Yes, they have.

Mr. Walker. The point I want to make is if we are going to successfully deal with the problem, isn't it necessary as we move the technology and move the science, to begin to develop policies that tie the help that we give in those areas to the political reforms that are necessary to make whatever scientific solutions that we offer them really viable economically and politically? Doesn't it make sense to move in that direction?

Dr. Chandler. To the extent that we can do this. I'm not a political scientist and I can't make a significant statement there, but certainly I agree that there are political problems which have inhibited technological development and food production increase and so forth and population control.

Mr. Walker. You all offer some ideas that are certainly worthy of consideration in the scientific and technical realm. I guess my suggestion is that none of that is going to make much difference in Ethiopia as long as Mengistu has made a conscious determination to starve a significant portion of his population.

Dr. Chandler. The same in Sudan, Southern Sudan.

Mr. Walker. Yes, in Sudan the same way, that's exactly right.

Dr. Chandler. There is no question about that.

Mr. Walker. We do have a political and economic component to this that is kind of outside the jurisdiction of this Subcommittee in many ways—

Mr. Scheuer. Hold the phone- hold the phone.

[Laughter.]

We recognize nothing as being outside of our proper jurisdiction.

[Laughter.]

Mr. Walker. But it does seem to me as we look at potential programs of international—

Mr. Scheuer. That was off the record.

[Laughter.]

Mr. Walker. I'll ship that to John Dingell and you'll be in big trouble.

[Laughter.]

But it does seem to me as we enter into areas of scientific cooperation to deal with some of these programs that those areas of international cooperation have to be multi-faceted in their approach or we are not really going to deal with the true nature of the problem.

I saw somebody else wanting to make a comment there a minute ago, and I think I stepped on them.

[No response.]

All right. Thank you, Mr. Chairman.

Mr. Scheuer. Thank you, Bob.

Chris.

Mr. Shays. Dr. Gordin, I really thank you for being here.

I just was listening to your statement and trying to really fully grasp what the potential is in mariculture in terms of a percent of what it could do to the total production of food and so on.

And let me just state the other question I had. I have a hard time never having seen this to visualize whether this takes place actually in separate areas, man-made waterways or whether it's something that would take place in natural rivers, lakes or oceans.

My last question is, given the pollution that seems to happen in a good part of the world, is that an obstacle? I mean what we are doing, for instance, to our 192 estuaries in this country, which produce 75 percent of our fish food, is insanity.

For instance, in Long Island Sound where I come from in Connecticut, do we have the ability to see this kind of operation take place?

Dr. GORDIN. Well, I'll answer one question at a time. As far as the potential is concerned, the sky is the limit really. If you are talking about total fisheries landing on an annual basis of let's say 80 million metric tons a year, then this provides the fish meal to the pork industry and the cattle industry and all the poultry. It's a very basic commodity. This is more or less what the oceans can provide us. I mean the population of the fish in the ocean is finite. They are not indefinitely large and you can harvest them or you can fish them only at the rate of their recruitment, annual recruitment. If you try to encroach on the capital, then you destroy them, and this happened many times in the past.

As we have seen in the first lecture that we had this morning, it takes years for populations to recover from that, if at all. For example, the population in California never recovered.

Mr. SHAYS. Well, there was a statistic there that said five years.

Dr. GORDIN. Yes. Sometimes it does take five years if you didn't really kill the population altogether, but if you did, then it won't come back.

The experts the world over estimate that if an investment of a rate of about $2.5 billion a year is put into the field of mariculture, we will be able to provide in a low-technology level and not high tech of getting to the level of fisheries landing within 10 to 15 years, that is producing in aquaculture or mariculture something around the figure of 100 million metric tons a year.

Mr. SHAYS. I can't relate to tons. If you told me it could feed the population of a certain State or country, you know.

Dr. GORDIN. What I'm trying to say is that it will double the landing of fisheries today, and the fisheries today is supporting today let's say comfortably the world as we knew it say 10 or 20 years ago.

Mr. SHAYS. Does most of our harvest, is it mostly fish food for human consumption or is a good part of it for animal consumption?

Dr. GORDIN. About 30 percent is going to fish meal, which then will be put into concentrated feeds for cattle, poultry and so on. This is the main protein source.

Mr. SHAYS. I don't learn if I don't expose my ignorance in the process sometimes, but I have a difficult time understanding how you provide the food for the fish so that the food that is being consumed by the marine life isn't more expensive than the final product.

Dr. GORDIN. You're touching on a very important point. See, the mariculture that we are developing in my institute in Eilat is aimed at the wealthy markets of the world. It's a gourmet fish that pays a tremendous amount of money, and economically it's worthwhile to invest in it whatever we invest in it.

Mr. SCHEUER. Excuse me, to meet what market?

Dr. GORDIN. The wealthy.

Mr. SCHEUER. Where do you export it to?

Dr. GORDIN. Europe, mainly Europe and hopefully to the United States or maybe Japan even. We're talking about a fish that gets let's say in terms of pounds and dollars something like $6 to $7 a pound to the farmer.

So on that type of animal or organism that we have domesticated, we have broken through many let's say barriers and bottlenecks in the technology of domesticating wild marine organisms, which means that on the basis of the technology that we have developed we can now take fish that are much lower on the food chain and the traffic level which are heavy for us and they hit directly the prime producers and then you won't have to put this fish meal back into production fish. See what I mean?

For instance, one of the fish that we are working together with the Egyptians on, is the mullet, the gray mullet, which is a heavy growth fish, it grows very fast and it has a very wide environmental tolerance of waters like salinity and temperature and so on, and it's a fast grower, and we feel this will provide a fantastic animal to grow all over the tropics and subtropics.

Mr. SHAYS. Just to conclude because I asked a lot of questions at once, but is world pollution a problem for you?

Dr. GORDIN. Yes, and I'm going to that. So this is as far as the technology is concerned. I think what we, in quotation marks, the Western World is developing is the basis for technology that then can be applied, not directly, and a lot of research has to be done on it, research and development and up-scaling and so on, but this is the basis. If I have to spawn fish like the mullet, I have learned how to do the basic things with a sea bream that could carry on his back the R&D investment that we have made in it. So again the technology that we envision in the Third World is, at least to begin with won't be high taxing.

Mr. SCHEUER. Excuse me. Can I just ask a question that is related to Chris Shays' question. You say that you are producing this fish concentrate for animals, this protein concentrate.

Dr. GORDIN. Yes. The diet is about 35 percent protein.

Mr. SCHEUER. Now scientists have developed a protein concentrate made from an Alaskan crustacean called Crill. You've heard of that.

Dr. GORDIN. It's from the Antarctic.

Mr. SCHEUER. The Antarctic, yes, and it's a concentrate that is designed to feed Third World peoples and enhance their protein intake, and they are trying to figure out what forms it can be put in that meet national cultural preferences and all of that.

Now is it possible, is it economically possible that you and the Egyptians perhaps working together or working separately could develop from your fish farming a protein concentrate that would be appropriate not just for animals, but for the human populations of the developing world and for Egypt's own teeming millions and for people is sub-Saharan Africa who are not very far away?

This would be a tremendously important development if you could produce that protein concentrate not only for animals and not only for the dinner tables of the rich developed mostly western countries, but if you could develop that concentrate in a way comparable to the way Crill has been developed to help provide protein intake for the developing world.

What is the economic feasibility of that mission? If you could develop a feasibility analysis where that would make economic sense, you would open up a door to literally billions and billions of dollars worth of market there, and perhaps engage some kind of support from the African Development Bank, the Asian Development Bank, the InterAmerican Development Bank, the World Bank and the various donor agencies in your effort to vastly enhance production at a level that the Third World markets could meet.

Dr. **Gordin.** I can relate to that. First of all, one has to understand that the Crill is a natural resource. We are just harvesting it, and we should harvest it again not more than it's possible to harvest or otherwise you'll destroy this resource.

Now there was some problem with the Crill as far as its protein quality was concerned. It wasn't exactly fit to suit human direct consumption, and mainly Germany is working on that as far as I know.

Now if you will remember while visiting Eilat we have shown you the Altimia, the brine shrimp culture that we are conducting, and this is a very small primitive crustacean who has a relatively simple life cycle and it produces cysts when the conditions in the environment are not very favorable and then you hedge those cysts, and we have shown that under certain culture conditions one can produce a tremendous amount of crustacean meat per unit time per unit area.

I'm talking about a tank of about five cubic meters, if you can envision it, over a period of two weeks will produce 60 to 80 kilograms of meat, and this is fantastic. This is feeding on algae that is grown naturally in the fish ponds. We are just cycling the water through it. So the technology is there, and I don't know whether it's today feasible economically or not, and the question of economic feasibility, one has to understand, is not the same in Israel or in California, and for sure it's not the same in Kenya or Senegal or any of those sub-Saharan countries. The economic considerations are totally different because there we are talking about subsistence.

Here we have to show that the technology that we are developing is economically viable under our conditions which are different from others. It calls, of course, for a study.

Now back to your questions, as far as the technology is concerned, just to give you an idea, we are talking as far as the grow-out is concerned, that is say fattening up the organisms, from let's say finger length up to market size, we are talking about two major basically different systems. One is floating cages out at sea, and there you can stock the fish quite densely due to the fact the water at sea is exchanging water at a very fast rate, and we have come to densities of about 250 fish, marketable fish to one cubic meter. So you can imagine, it's like a floating sardine can.

But this is limited I think in its scope because we are not controlling the pollution caused by the farming itself to the environment, and if one wants to maintain the environment from which one pumps water for its operation, one should be very careful about it and thoughtful about it.

Now the other way is growing them in ponds. Now we in Israel are growing them in ponds and the technology is just developing.

Mr. **Shays**. Growing them in?

Dr. **Gordin**. Ponds, p-o-n-d. Sorry, I apologize for my accent.

Mr. **Shays**. You don't have to apologize. It's wonderful.

Dr. **Gordin**. Thank you. We are lining the soil at the bottom of the ponds with plastic lining so there is no seepage of seawater to the underground water aquifers, which are of course in Israel very important and could be important to everyone, which makes the technology a bit more expensive.

Through the ponds we are circulating seawater at the rate which would not allow the salinity in the ponds, in the water to increase beyond a certain physiological level that we have set.

Now as far as the pollution is concerned, I think we are on the verge of having a technology that will strip from the water which goes back to the sea after making the mariculture from all its nutrients and pollutants by using algae-like growth and getting another crop and cleaning the water.

Mr. **Shays**. You are actually saying to me, I think, that the process creates pollution. I was thinking of outside external pollution.

Dr. **Gordin**. Well, first of all, let us not contribute to the external pollution, which is a major problem. I can tell you that last year in Norway that really went logarithmically with its development of mariculture there in the fiords growing salmon in pens, they are really facing very, very severe problems in polluting the environment.

So the contribution that mariculture can have once it goes on a very large scale is very significant. So this is one thing.

The other thing of course is to handle the pollution that mankind provides at sea or insults the sea with, and this is a major problem. I think that some of the techniques that we are developing to cope with the pollution that mariculture causes will be able to be implemented later on into sewage and other types of treatment.

Mr. **Shays**. This has been fascinating. I'm just going to throw this out. The one trouble that I have to reconcile is if we are creating more food for people to eat and in essence encouraging a greater population in the process, I don't know what that says, but it troubles me. I raise that as a concern, and it just seems to me that whatever progress we make with food, we have to make it with population growth.

Dr. **Gordin**. I'm not an expert on that at all. I am not a demographer. I am a marine biologist by training. But just listening this morning and reading of course a lot in the last decade or so, there is no question in my mind that problem No. 1 is population growth. I mean if we stop that, 50 percent or 70 percent of our problem is solved I believe.

But we, and I say we, the Western World, does not talk, the Western World does not talk in one voice on that.

Mr. **Shays**. I know, and not one voice in this country.

Dr. **Gordin**. No, no, that's what I'm talking about. It's the U.S., and it's even in my country. I mean birth control is unheard of in the Jewish faith. So it's a problem, and it's a problem everywhere. So we have to solve that. We will just help by providing a bit more food, that's all.

Mr. SHAYS. Thank you, Mr. Chairman.

Mr. SCHEUER. There is a political problem, as I understand it, with mariculture. That is, if a commercial concern, a marine operator wants to function on a commercial basis, that concern must obtain guaranteed access and exclusive use of specific marine areas offshore, is that not true? They have to carve out a hunk of the ocean a mile wide, a mile deep and a mile long.

Dr. GORDIN. Well, you're right.

Mr. SCHEUER. And that's the ocean, okay, and I suppose if it's within the limits, whatever the limits are over which that nation has jurisdiction, the country can do it. In many cases, as I understand it, nations have leased such areas to commercial marine operators, contractors.

Has there been a certain amount of resentment on the part of competitors or the public at giving exclusive rights to a hunk of the marine environment to a private commercial concern? What are the political issues there that we have to face up to? This is the kind of thing that Chris Shays and Bob Walker were talking about, political constraints on increased food production and increased food delivery to where the people are who need it. What kind of political problems do we have to find answers to?

Dr. GORDIN. Well, people, first of all, I think resent, basically resent new development, and if you have a bunch of fishermen who for generations were fishing the same area, and then comes a guy or a company which has the technology to start a mariculture farm, they feel threatened and they will fight it all the way. There are many cases in courts in the United States on the West Coast that are an example of this problem.

However, I think that this is merely again a Western World problem. It is not a problem, let's say, in Egypt. In Egypt the Governor will tell them to put a mariculture farm there, and they will put a mariculture farm there, or in Kenya or anywhere.

So I hope we won't export this problem from our countries to their countries and enlighten them because here, for instance, you cannot put a mariculture or any structure out at sea offshore that will obstruct the view of the people who are walking on the shore. This is something that is in most States in legislation.

Mr. SCHEUER. Is that a California disease exclusively?

Dr. GORDIN. Well, it's in Oregon and I think it's even in Alaska, if I remember Alaska. For sure the East Coast States going all the way down from Maine down to Florida. It's an amazing thing and there is a lot of articles on that in the American aquaculture literature, and if you are interested you can get it.

Mr. SCHEUER. I would be interested. What kind of obstruction of view would be necessitated by a commercial marine fisheries operation?

Dr. GORDIN. You know, this is why the oyster business in this country, the oyster farming in this country is using only the sea bottom rather than the water column like the Japanese and the Koreans are doing. They are using a three-dimensional world to grow the oysters. Here in this country they are using just the bottom and the oysters see just the water that flows above it.

So you cannot put rafts, you cannot put structures from which you hang cages of oysters of what-have-you. This is against the law here.

But, again, as I say, if we are relating the problem of food production in the Third World, there it's not a problem, as far as I know.

Mr. SCHEUER. How about in Israel, do you have a problem with you mariculture over there?

Dr. GORDIN. Of course, we have a problem. What do you mean. We have fishermen that feel really threatened and they even went all the way to the government to tell them that mariculture should be forbidden. Then even within the government we have the Port Authority that, and I don't know by which law they got the right to tell who is going to do what uses of the three-mile limit. So we are confronting them. But I think it can be solved eventually.

One has to understand that we don't have yet the technology to go really out at sea, far offshore to maintain cages or any structures that will be strong and immune. This will take time. The Japanese are there more or less with huge cages, 7,000 cubic meters cages in which they grow the tuna, but they are the only ones in the world now.

If you want to expand the use of the surface of the ocean for mariculture, this type of technologies of anchorage and withstanding storms and sea energy is of utmost importance.

Mr. SCHEUER. Chris?

Mr. SHAYS. No questions.

Mr. SCHEUER. Well, Dr. Gordin, thank you very, very much for your testimony. I think you have won the door prize for having traveled the greatest distance to come to this hearing, and it was very worthwhile and you made an outstanding contribution. We are very grateful to you.

We will now hear from Pedro Sanchez, whom you have heard from before and whom my colleague from North Carolina introduced, of North Carolina State University.

As I have said before, your full testimony will be printed in the record. So please take your five or six minutes and I'm sure we will have some questions for you.

STATEMENT OF DR. PEDRO SANCHEZ NORTH CAROLINA STATE UNIVERSITY

Dr. SANCHEZ. Thank you, Mr. Chairman.

What I will do is go through the testimony, and then I would like to show you some slides of what the situation is, and then come back and finish it up.

I very much appreciate the privilege of appearing before your Subcommittee today to report that there are science-based, sustainable agricultural options to slash and burn agriculture and that they can drastically retard tropical deforestation rates.

This is based on research conducted primarily in the Amazon of Peru and it shows that for every acre farmers put into the various sustainable management options that 5 to 10 acres of tropical rain forests could be saved every year- every year from the shifting cultivator's ax.

The widespread application of these technologies throughout the humid tropics has yet to take place and needs to be widely tested. It requires strong collaboration between scientists and policymakers and between developed countries and those that have suffered rapid deforestation rates and those involve a major global effort. I believe that such an effort is definitely in the U.S.'s enlightened self-interest.

The program that I am about to outline makes food production compatible with environmental conservation. The sustainable agricultural technologies that North Carolina State University tropical soils programs have been working on for 17 years are designed for humid tropical areas with a heavy influx of new farmers.

The U.S. Agency For International Development has funded the bulk of this program since 1972 due to the enlightened support of a few key people, such as John Malcolm and Nyle Brady.

The tropical soils program is based on the striking similarities between the main soils of the Southeastern United States for slash and burn agricultural use that took place decades ago and the main soils of tropical rain forests areas which are red, acid and of low native fertility.

Instead of proposing one solution, our team and our associates in Peru and Brazil and Indonesia and other countries present a series of sustainable management options adapted to different soils, landscape positions and different levels of socioeconomic developments.

The principal ones are paddy rice production in alluvial soils, low-input cropping, which is a fairly new concept, continuous cultivation, pastures and agroforestry.

Additional options developed by other research institutes include perennial crop production, rubber and oil palm, plantation forestry and now they are cropping for higher fertility soils. They are also part of the solutions.

I would like to place in the record the background materials that describe this deforestation reduction initiative and the technologies upon which it is based.

Now the overall linkages. One of your requests, Mr. Chairman, was to identify the specific linkages between world population growth and natural resource degradations.

These linkages are identified in the figure following page 4 in the testimony, and I would like to go over it, and in case some of you up there don't have it, I have still saved a few copies from the press.

I would like for you to go over what I somewhat facetiously call a "horrendogram," but it puts together some of the issues here.

We have first the driving variables, the Third World population growth that we have been talking about, second, limited fertile land and, third, land tenure inequities in many countries, the uneven distribution of land.

The result of that is the large landless rural population, and they basically have three choices, stay where they are, rural stagnation, migrate to the urban centers or migrate to the humid tropics in those countries where there are humid tropical rain forest areas. In some there are not.

If you stay in the highlands, the pressure keeps going on and you have increased erosion in the steep lands and people move up further and further up in the hills. This has caused a lot of erosion and siltation reservoirs and farm sizes have grown so small now in which farmers now have to split their acre of land to their two or three sons and so on.

People migrate to the cities and, unfortunately, in areas affected by the rain forests like in Latin America, we now have the dubious honor of having the largest cities in the world. There is very limited urban infrastructure and the urban capacity is exceeded by all these problems.

When I lived in Lima, a city of six million people, half of them lived without any electricity, running water or sewage systems. The cities are beyond capacity.

Mr. **Scheuer**. Mexico City.

Dr. **Sanchez**. Mexico City and many others, Bogota, et cetera. Well, that's on the urban side. Let's go to the other side and the adventurous ones who migrate to the humid tropics, the classic pioneers.

Most of them, or all of them are newcomers to the system and they begin to practice shifting cultivation and disequlibrium. Shifting cultivation is slash and burn agriculture. The local people know how to do it, but when the new people come in, they do it in disequlibrium.

Mr. **Scheuer**. They do it what?

Dr. **Sanchez**. They don't do it well. They do it in disequlibrium. In other words, they don't allow the forests to regenerate for 12 or 15 years, which is what is needed.

Now in some other countries, like in Brazil, there has been a lot of land speculation and clearing for the purposes of land speculation, although policies have changed there.

In both cases you have the result of what I call unsustainable agriculture that triggers economic failure and many of the people go back to the cities and go into urban unemployment or go to the cities for the first time.

Traditional societies are disrupted, and what we begin to see at the end of this horrendogram is two very bad consequences, further urban unemployment and further deforestation.

The first one eventually causes revolution, social upheaval and certainly crime and higher inflation in the cities.

The second one, deforestation, depletes our soil resource base, there is a tremendous loss of genetic diversity by additionally clearing the forests and an accelerated greenhouse warming effect which, according to EPA, 20 percent of the greenhouse effect is due to tropical forest deforestation.

So that's the overall picture. The question is now can these trends be alleviated and eventually reversed? And our answer based on long-term research is an emphatic yes with the use of alternatives to slash and burn.

I wish Congressman Walker was here because the key is an integrated approach that consists of three things: the development and application of sustainable management technology for tropical soils, the technology part, the second part is the appropriate government policies that provide incentives against further deforestation, and the third part, effective economically sound rain forest conservation methods.

In other words, technology alone is not going to do it, policy alone is not going to do it and we need them both. People don't cut tropical rain forests because they like to. They clear them out of sheer necessity to grow more food, and deforestation therefore can be reduced by the widespread application of sustainable management practices that permit the use of cleared land on a continuing basis.

Sustainable management options for acid soils of the humid tropics have been developed in Peru and elsewhere to fit different landscape position soils and level of socioeconomic infrastructure development, and I have another simple diagram that shows the different landscape positions in the humid tropics, different kinds of soils and where these different options fit, and you are cordially invited to see it by yourselves if you would like to come down to the Amazon with me.

But since you cannot do it this morning, I would like to show you some slides about it.

[Slide presentation.]

I will just quickly go through some of these options and some of these limitations as well.

[Slide.]

This is a classical problem of tropical deforestation.

[Slide.]

And these are the culprits. These are the evil people who are clearing our forests. Eighty percent of the tropical deforestation is done for slash and burn agriculture. Of course, these are not evil people. They do it because they have to. These are the migrants who are coming in. This family, that's all they have.

Mr. SHAYS. Let me just ask you though, it's a new phenomena though, isn't it?

Dr. SANCHEZ. No, sir. We had shifting cultivation in the United States.

Mr. SHAYS. I'm talking about in the Amazon it's a new phenomenon in terms of magnitude or not?

Dr. SANCHEZ. Yes, it's new in terms of the urgency of the situation now. It occurs all around the world, but now it's really, really hitting proportions like in the town where we were working, Yurimaguas, where there is no government program to colonize and the mayor of that town says there are six families arriving by foot every day.

[Slide.]

This is how the Yurimaguas Research Station looks, just to show you that it is in the humid tropics in the low-land areas. It's typical of the acid infertile soils and the high rainfall in an area where shifting cultivation has hit.

[Slide.]

Again, our landscape diagram with the different management options. Paddy rice right out of Southeast Asia, continuous cropping makes a nice agriculture where that is socially and economically acceptable, low-input cropping, pastures and agroforestry, and I won't talk about the rest.

[Slide.]

The first thing is use your better lands first. There are alluvial soils in the Amazon jungle that have fairly high fertility, and basically we borrowed technology developed by Robert Chandler and his associates at IRRI and put them to work on the better lands where there is good demand for rice at a stable price and farmers are growing two crops of rice per year very well there.

[Slide.]

The key now is how do you go from shifting to continuous cultivation, and the key is what we call low- input cropping for acid soils, a transition technology.

[Slide.]

We asked farmers about 10 years ago what is your fondest dream, shifting cultivators, and they said to grow a second crop of upland rice so we can make some money. Why can't you do it? Oh, because of weeds and they didn't see the soil fertility. We said, okay, let's give us a try.

[Slide.]

We developed a low-input system based on a few principles, the use of acid tolerant crops, breeding varieties that could tolerate the soil so you didn't need to add lime and other expensive inputs, capture the nutrients in the slash and burn, don't use a bulldozer to clear it, but slash and burn and capture the nutrients in the ash, recycle those nutrients to death, no tillage, just a planning stage, a few chemical inputs and a managed fallow to control the weeds when the system comes down.

[Slide.]

Very rapidly here you have it with acid tolerant varieties of rice.

[Slide.]

Careful management to make sure that all the straw stays here so you ~~nutrients are~~ recycled.

[Slide.]

Then acid tolerant varieties for cowpeas or black- eyed peas. You have a rotation and you can get two or three crops of these for about two to three years. So instead of just getting one crop with shifting cultivation in these areas, now you are getting anywhere from five to seven crops. Then the system conks out.

[Slide.]

And when it does, we have some options. You never want to put the farmer in a corner. You want to always have options. The options are you can start with a fallow on a second cropping period and we use Kudzu, you can shift to a high-input system, if that's economically correct, you can plant pastures or you can go into agroforestry.

[Slide.]

This is one of the technologies that has worked fairly well. When the system conks out, instead of going back to secondary bush, put it in a useful fallow and we use Kudzu, tropical Kudzu, which is a little bit different from the one we have in the south, but anyway the thing covers the ground in about three months, kills all the weeds and there is no problem with erosion.

[Slide.]

After a year or so slash and burn the Kudzu, and I wish we didn't have to do this, but we have to.

[Slide.]

Then we grow another crop and start the cycle again, although we don't know how sustainable the second or third cycle is going to be. We are into research into that right now.

[Slide.]

Your land-clearing process is complete after two or three years here, and whatever tree stumps you have left you can just about kick them out with your feet. Then that gives the farmers a bunch of options. Supposedly if roads and infrastructures have been developed, you can go into what we call mechanized agriculture.

[Slide.]

With the use of lime and fertilizers you can grow three crops a year. We have been doing this continuously on the same piece of land in the Amazon of Peru since 1972. We have grown 40 crops. So it can certainly be done and it's certain sustainable, but it requires a marketing system only that would be around the large cities in the Amazon and will have a very limited, probably a very limited initial impact as opposed to the low-input system.

[Slide.]

You can grow a crop such as corn and so on pretty well over there under high-input systems on a sustainable basis, and it doesn't damage the soil if you do it right.

[Slide.]

A third option is pastures, and this is a very important option and one that has a horrible reputation in the rain forests because of lack of technology, but through working with the International Center for Tropical Agricultural in Colombia there have been developments of acid tolerant varieties of pasture grasses and legumes. Here you see them in an Indian community intercropped with a last upland rice crop of a low-input system, shifting from a low-input system into pastures.

Mr. **Scheuer**. Dr. Sanchez, you're going way over your time. I really regret this.

Dr. **Sanchez**. Do you want me to stop?

Mr. **Scheuer**. Well, take one minute to wind up.

Dr. **Sanchez**. Yes, sir.

[Slide.]

The pastures look like this, and then I'll stop with agroforestry.

[Slide.]

New crops which are tolerant to acidity produce while the farmers are still going through low-input systems.

[Slide.]

You can go through and get crops about half the feeding value of a sweet potato. These are new plants coming out of our genetic diversity in the rain forests.

[Slide.]

Mr. **Scheuer**. That's a crop that you grow in the tropical forests?

Dr. **Sanchez**. Yes, sir, that comes from the tropical forests.

Mr. **Scheuer**. And those crops grow in harmony with the tropical rain forest?

Dr. **Sanchez**. Yes, sir, and now we are growing them separately in a plantation system and not extracting them out of the forests. Our idea is to leave the forests. Mr. Chairman, these are basically the technologies, and I'll stop right here.

[The prepared statement of Dr. Sanchez follows together with article reprints:]

UNITED STATES HOUSE OF REPRESENTATIVES
SUBCOMMITTEE ON
NATURAL RESOURCES, AGRICULTURAL RESEARCH AND THE ENVIRONMENT
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY

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Testimony prepared by

Dr. Pedro A. Sanchez
Professor of Soil Science and
Coordinator, Tropical Soils Research Program
North Carolina State University
Raleigh, NC 27695-7619
919/737-2838

Mr. Chairman,

I appreciate the privilege of appearing before your Subcommittee today to report that ***there are science-based, sustainable agriculture options to slash and burn agriculture and that they can drastically retard tropical deforestation rates***. Research conducted in the Amazon of Peru show that ***for every acre farmers put into the various sustainable agricultural options, 5 to 10 acres of tropical rainforests could be saved every year from the shifting cultivator's ax***. The widespread application of these technologies throughout the humid tropics, requires strong collaboration between scientists and policy makers, and between developed countries and those that have suffered rapid deforestation and thus involves a major global effort.

The program I am about to outline makes food production compatible with environmental conservation. The sustainable agricultural technologies North Carolina State University's Tropical Soils Program have been working on are designed for humid tropical areas with heavy influx of new farmers. The US Agency for International Development has funded the bulk of this program since 1972. The Tropical Soils Program is based on the striking similarities between the main soils of the Southeastern United States, (where slash and burn agriculture used to take place), and the main soils of the tropical rainforest areas, which are red, acid and of low native fertility. Instead of proposing one solution, the NC State team and its associates in Peru, Brazil, Indonesia and other countries present a series of sustainable management options adapted to different soils, landscape positions and different levels of socioeconomic development.

The principal sustainable management options and alternatives to slash and burn are: paddy rice production on alluvial soils, low-input cropping, continuous cultivation, legume-based pastures, and agroforestry. Additional options developed by other research institutes include perennial crop production (rubber, oil palm), plantation forestry and alley cropping for the higher fertility soils (1, 2)*. They are also part of the solution.

I would like to place in the record background materials that describe this deforestation reduction initiative and the technologies upon which it is based (3, 4, 5).

References and notes at the end of the statement.

THE OVERALL LINKAGES

One of your requests, Mr. Chairman, was to identify the specific linkages between world population growth and natural resource degradation. These linkages are identified in Figure 1, for the countries in the Third World that have tropical rainforests.

Third World population growth continues at a high rate, while most of the fertile and accessible lands are already intensively utilized. Government policies often exacerbate land scarcity by allowing gross inequities in land tenure. These factors result in an increasing landless rural population which essentially has three choices: ***stagnate where they are, migrate to the cities, or migrate to the rainforests*** that constitute the frontier of many tropical countries. Although urban migrations are spontaneous, national policies in key countries include the occupation of their tropical rainforests, notably Brazil, Peru and Indonesia via colonization programs.

Densely populated rural environments such as the Andean valleys, Central America, Northeast Brazil, and Java suffer from an ever-decreasing farm size and the overuse of steepland areas. This results in widespread soil erosion, siltation of reservoirs and other adverse off-site effects to urban centers. Migration to the cities in search of a better life results in bitter disappointments and, coupled with limited urban infrastructure, produces unmanageable cities with populations far exceeding their carrying capacity and infrastructure. For example, when I lived in Lima, Peru, this city had six million people, half of them living without electricity, running water or a sewer system.

Migration to the humid tropics seldom results in a bountiful cornucopia. The equilibrium between the rainforest and shifting cultivation by traditional humid tropical societies is broken by the colonists, and in some countries by land speculators as well. As much as 80 percent of the cutting of the world's virgin tropical forests is by slash and burn to produce food, the rest being for other uses such as logging, pastures, roads, dams and urban development (6). The result is shifting cultivation in disequilibrium which quickly turns into various forms of unsustainable agriculture. Traditional societies are disrupted, economic failures abound and migration to urban centers follows.

The two end points are ***urban unemployment and further deforestation***. The consequence of the former is abject urban poverty which leads to widespread crime, poor health and in many cases social upheaval and terrorism. Deforestation depletes the ecosystems' limited nutrient capital, decimates plant and animal genetic diversity and accelerates global warming due to carbon dioxide and nitrous oxide emissions. EPA estimates that about 20 percent of the global warming is due to tropical deforestation (7).

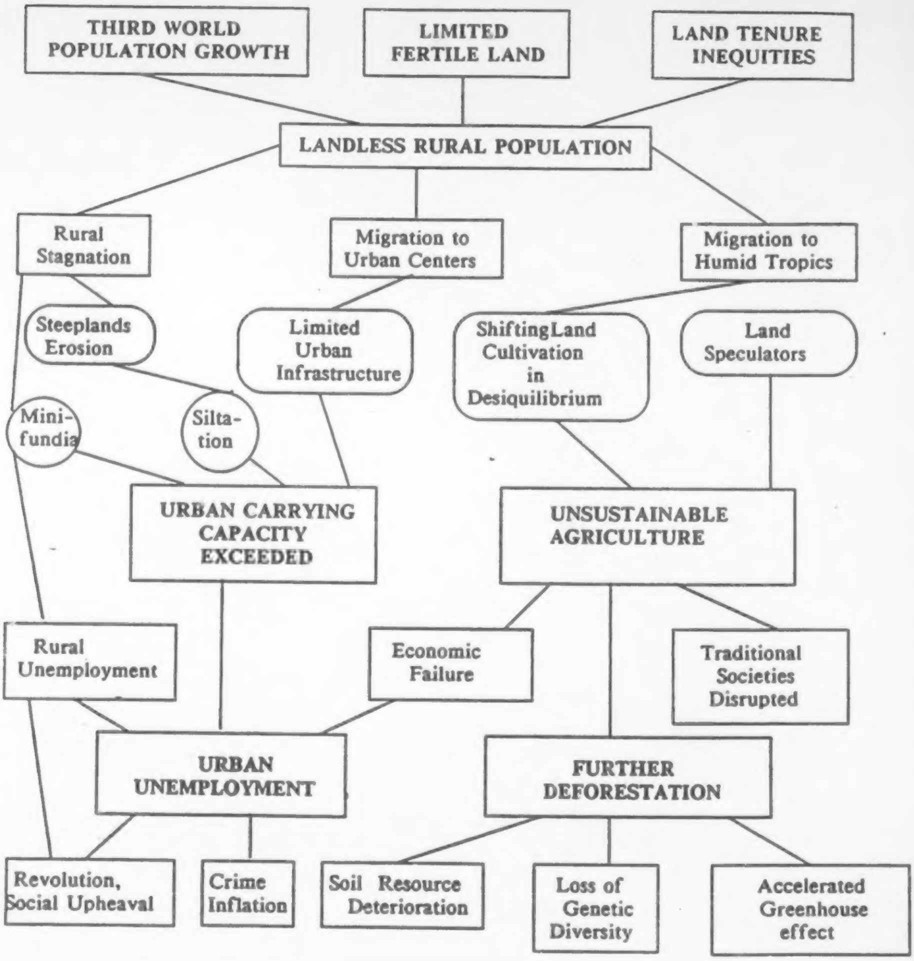
THIRD WORLD POPULATION GROWTH
LIMITED FERTILE LAND
LAND TENURE INEQUITIES
LANDLESS RURAL POPULATION
Rural Stagnation
Migration to Urban Centers
Migration to Humid Tropics
Steeplands Erosion
Limited Urban Infrastructure
ShiftingLand Cultivation in Desiquilibrium
Land Speculators
Mini-fundia
Siltation
URBAN CARRYING CAPACITY EXCEEDED
UNSUSTAINABLE AGRICULTURE
Rural Unemployment
Economic Failure
Traditional Societies Disrupted
URBAN UNEMPLOYMENT
FURTHER DEFORESTATION
Revolution, Social Upheaval
Crime Inflation
Soil Resource Deterioration
Loss of Genetic Diversity
Accelerated Greenhouse effect

Figure 1. Cause-effect relationships in conservation-development in tropical countries.

THE SOLUTIONS

Can these trends be alleviated and eventually reversed? Our answer, based on long-term research, is an emphatic ***yes, with the use of* alternatives to slash and burn.** The key is an integrated approach consisting of a) development and application of sustainable management technologies for tropical soils, b) appropriate government policies that provide incentives against further deforestation, and c) effective, economically sound rainforest conservation methods.

People do not cut tropical rainforests because they like to; they clear them out of sheer necessity to grow more food. Deforestation, therefore, can be reduced by the widespread adoption of sustainable management practices that permit the use of cleared land on a continued basis. Sustainable management options for acid soils of the humid tropics have been developed at Yurimaguas, Peru, and elsewhere to fit different landscape positions, soils and levels of socioeconomic infrastructure development (Figure 2).

Most of the options are based on low-input systems which serve as transition technology to agroforestry systems, legume-based pastures and continuous crop rotations. In spite of the continuing need for both strategic and applied research, there is no question that the technological basis for sustainable management options for acid soils of the humid tropics is available now.

Land Clearing that does not damage the soil

All the options are based on slash and burn, using axes, machetes and chain-saws as opposed to mechanized bulldozer clearing. We found that the slash and burn system is better because the burn provides a liming and fertilizing effect of the ash, does not disturb the topsoil while conventional bulldozer clearing often compacts the soil and removes valuable topsoil (8). When our results were transmitted to our colleagues in Brazil and Indonesia, policies to discourage bulldozer clearing were instituted. We also found little difference in fertilizer content of the ash after burning primary or secondary forests (9) giving a further impetus to clear secondary forests, instead of primary ones.

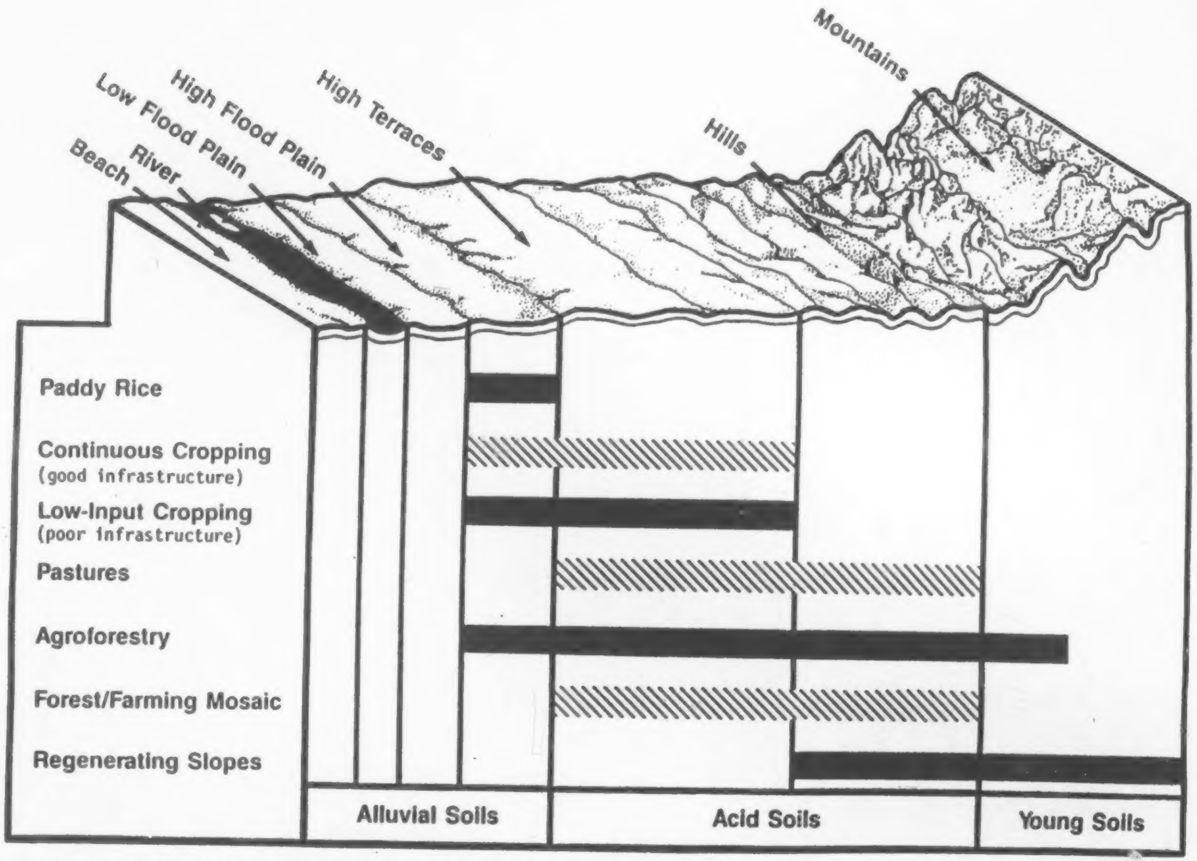

Figure 2. Some soil management options for humid tropical landscapes dominated by Oxisols and Ultisols (3).

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Flooded Rice in Alluvial Soils

One obvious option is to first use intensively the best soils available in the area: the alluvial soils of most humid tropical rivers which are naturally fertile but are not subject to annual flooding. Traditional paddy rice production technology developed by Southeast Asian farmers, coupled with high yielding varieties suitable to local tastes and appropriate agronomic practices has been successfully adopted by settlers and local people in the Amazon of Peru. With low-cost supplemental irrigation, farmers harvest two crops per year averaging 5.5 tons/ha or 11 tons of grain per hectare per year. This is practiced in over 50,000 hectares of the Peruvian Amazon under the leadership of Peru's National Rice Program (10). There is great internal demand for rice, a guaranteed price and sufficient infrastructure to deliver this basic food to the rest of the country. However the product is not of sufficient quality for export markets.

Low-Input Cropping for Acid Soils

In the vast majority of the humid tropics the soils are acid and with low fertility and farmers slash and burn forests to produce one or two crops of rice or corn each averaging about 1 ton/ha of grain before leaving the land in a forest fallow. Then they cut additional forest the following year. A low-input cropping system was developed in Yurimaguas, Peru to serve as a transition technology between shifting and continuous cultivation (4). Its main features are:

- Slash and burn secondary forest fallows.
- Use of acid-tolerant crops.
- Capture nutrients in the ash.
- Maximum nutrient recycling.
- Zero tillage (only a planting stick is used).
- Managed fallow to control weeds.

Acid-tolerant varieties of upland rice and cowpeas (black-eyed peas_ were found to grow very well at a very acid soil pH (4.5) without liming. Seven crops of a rice-cowpea rotation were harvested in a three year period with high grain yields. By carefully returning all crop residues (rice straw and cowpea stover) to the field we were able to recycle 54% of the nitrogen, 70% of the magnesium, 89% of the potassium, 95% of the calcium but

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only 38% of the phosphorus accumulated by the crop. In addition nitrogen fixation by the legume cowpea must have contributed to the nitrogen balance. The problem is phosphorus since this element is concentrated in the grain and is thus removed from the field by harvest. Although no fertilizers, or lime were added to the field, what farmers remove in their crop harvest must eventually be returned back to the soil in sustainable agricultural systems. If not we are mining the soil of its nutrients.

Crop yields declined with time due to phosphorus deficiency and increasing weed pressure which could not be economically controlled by low cost herbicides. The system was then put into a managed tropical kudzu fallow, which rapidly covered the ground, smothered the weeds and totally protected the soil from erosion. After one year, the kudzu was slashed and burned and a second cropping cycle started. Unlike the species of kudzu that grows in Southeastern United States (Pueraria lobata), tropical kudzu (Pueraria phaseoloides) does not develop storage roots and is thus simple to eradicate by slash and burn. This low-input system was found to be highly profitable averaging $1144 per hectare per year or 121 percent return over total costs, which were largely hand labor by small farmers (4).

This low-input system, therefore, is a transitional technology in both agronomic and economic terms. After three years, the field is devoid of felled logs and most of the remaining tree stumps are sufficiently decomposed to be easily destroyed. The land-clearing process is thus complete, providing several options to the farmers, such as the following: to put the land into a managed fallow and then start a second cropping cycle; to plow, lime, fertilize, and rotate crops intensively; to establish pastures; and to establish agroforestry systems.

Managed fallows

Traditional shifting cultivation involves a secondary forest fallow period of 4 to 20 years, to replenish soil nutrient availability and control weeds. Farmer experience around Yurimaguas indicates that a minimum desired age of fallow is about 12 years, but population pressures effectively reduce this period to an average of 4 years. Slashing and burning young forest fallows result in faster grass weed invasion than would occur in older fallows because the weed seed pool declines with age. Considering the limited likelihood of long secondary fallow periods in humid tropical areas in developing countries, the need for an improved fallow is apparent. Research is currently underway to test various leguminous species as managed fallows, in addition to kudzu. We still do not know whether a second or third cropping cycle is sustainable. Research is underway.

Continuous Crop Rotations

Another option is for the low-input system to serve as a three-year transitional period to intensive, fertilizer-based, continuous cropping systems for areas that have developed a sufficient road, credit, and market infrastructure to make this possibility attractive. The field is ready for mechanized tillage, provided that slopes are suitable, because most of the felled vegetation has decomposed. This system has proven to be sustainable with about 40 crops grown continuously in 17 years at Yurimaguas (11). In order to decrease weed infestation it is advisable to use a kudzu fallow before shifting to intensive crop production.

Legume-based pastures.

Pastures for beef and milk production are an attractive option in the Latin American humid tropics and one in particular need of improved technology because of widespread pasture degradation. The low-input system can also serve as a precursor to establishing improved, acid-tolerant pastures, beginning with the clearing of secondary forests. Income-generating food crops can be grown, and the pasture species may be planted either vegetatively or by seed under a rice canopy. Several combinations of persistent, acid-tolerant grasses and legumes have produced high and sustained live-weight gains of the cattle in Yurimaguas for eight years (12). Phosphorus and potassium fertilizers are apOplied annually or every two years. The kudzu fallow itself could be used as a pasture in rotation with grass-based pastures. Degraded pastures have been regenerated using similar techniques. Similar work has proven successful in the Amazon of Brazil (13).

Agroforestry

The low-input cropping system is a good way of providing cash income and ground cover during the establishment phase of tree plantations. The decision, however, has to be made early in order to plant the tree crops shortly after clearing and burning the secondary forest. Unless liming is contemplated, the choice of tree crops should be limited to acid-tolerant ones. Examples of acid-tolerant crops for industrial purposes are rubber, oil palm, and guarana (Paulinia cupana); for food production, peach palm (Bractis gasipaes); for alley cropping, Inga edulis. Woody species known to be sensitive to soil acidity, such as Theobroma cacao and Leucaena leucocephala, should be avoided.

The low-input system has been used successfully in Yurimaguas for the establishment of peach palm and multipurpose tree production systems that include fast-growing (Inga edulis) and slow-growing (Cedrelinga cataeniformis) forestry species (14).

DEFORESTATION REDUCTION

For every hectare put into these sustainable technologies by farmers, five to ten hectares *per year* of tropical rainforests will be saved from the shifting cultivator's ax, because of their higher productivity. Estimates at Yurimaguas for the various management options are as follows. These estimates will vary with climate and soils.

1 hectare in sustainable management options	Equals: hectares saved from deforestation annually
Flooded rice	11.0
Low-input cropping (transitional)	4.6
Continuous cropping	8.8
Legume-based pastures	10.5
Agroforestry systems	not determined

Such technologies are equally applicable to secondary forest fallows, where clearing emits less carbon dioxide emission to the atmosphere than primary forests because of smaller tree biomass. Also much of genetic diversity has been already lost in secondary forests . The use of secondary forest fallows is therefore, an excellent alternative to primary forest clearing. Many of the degraded or unproductive pastures or croplands resulting from poor management practices can also be reclaimed using some of these available technologies.

Such technologies, however, are useless without effective government policies that encourage, support and regulate them. Likewise, well conceived policies will fail without sustainable technologies. Therefore the hope lies on a joint policy-technology approach: The Deforestation Reduction Initiative (3).

The present situation is analogous to when the world technical assistance community launched the Green Revolution in the late 1960's. At that time sustainable technologies for high-yielding rice and wheat production were sufficiently developed to be tested at a large scale. Key government officials were convinced of their importance by leading scientists, and instituted the necessary policies to make massive farmer adoption possible in India, Pakistan, The Philippines and other countries. The Green Revolution became a worldwide success during the next twenty years and the goal of arresting worldwide famine was definitely achieved. Unlike the Green Revolution, however, the impact of the Deforestation Reduction Initiative will be gradual and less spectacular. This is because we are focusing on marginal ecosystems, and more complex technological and policy problems.

In conclusion, Mr. Chairman, a worldwide Deforestation Reduction Initiative will help directly the livelihood of both Third World countries and the developed countries as well. Sustainable agricultural options for the humid tropics are a necessary, but not sufficient conditions to stop tropical deforestation (15). Coupled with appropriate, conservation-oriented government policies the following objectives can be achieved at the same time.

- Increase food and fiber production by farmers now practicing shifting cultivation.
- Reverse the pattern of degradation of many of the lands already cleared of tropical rainforest.
- Preserve much of the remaining tropical rainforests with their rich genetic diversity.
- Alleviate emission of greenhouse gases by as much as 20 percent.

Thank you.

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SCIENCE

Soils of the Tropics and the World Food Crisis

P. A. Sanchez and S. W. Buol

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Soils of the Tropics and the World Food Crisis

P. A. Sanchez and S. W. Buol

The term "tropical soils" evokes widely different thoughts in specialists and scholars from several disciplines. Overgeneralizations about soils of tropical areas have led to many misconceptions about the potential of the tropics for food production. Much has been learned in the past two decades about the properties and management of such soils. Our purpose in this article is to outline the salient properties of soils in the tropics and the role of these soils in world food production.

Tropical soils can be quantitatively defined only as those soils which lack a significant summer to winter temperature variation; that is, the difference between the mean summer and mean winter temperature at a depth of 50 centimeters is less than 5°C (1, 2). Aside from this, the range of conditions responsible for soil formation is as diverse in the tropics as in the temperate regions. Rocks, the parent material of soils, are the same in both regions. Erosional and depositional patterns are not markedly different between the two geographic regions. In both tropical and temperate regions, the time of soil formation on any geomorphic surface may range from yesterday on floodplains or fresh volcanic ashfalls to undetermined antiquity on more stable surfaces. Arid and humid, hot and cold climates exist in both zones. The term "tropical soils," therefore, is as meaningless in conveying most soil properties as its corollary, "temperate soils."

Although soil formation in tropical areas is not different in kind from soil formation in the temperate zone (3), the areal magnitude of certain soil-forming patterns is significantly different. Much of the northern temperate zone has had its surface reworked by Pleistocene glaciation and carpeted by thick loess mantles. These processes have influenced the age of the soils and added an influential silt-sized component (2 to 50 micrometers) to the parent material that is frequently absent in tropical areas. Many more soils in the tropics have been formed from material that has been reworked since the Precambrian by the processes of surface erosion and deposition, which intensively weather the material. Although the areal extent of recent volcanic ash deposits is greater in the tropics, there is a larger proportion of relatively younger soils in the temperate region.

Generalizations beyond these statements begin to lose accuracy. The statements that laterite and lateritic soils are prevalent in the tropics and that tropical soils have low organic matter contents are two generalizations that have tended to hinder understanding of tropical soil conditions.

The Laterite Exaggeration

Probably no greater misunderstanding about soils exists than the concept that there is a uniquely tropical soil-

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P. A. Sanchez is associate professor and S. W. Buol is professor in the Department of Soil Science, North Carolina State University, Raleigh 27607.

forming process that leads ultimately to laterite. When European and American soil scientists traveled to the tropics during the 19th century, they were intrigued by the presence of laterite. Back home they wrote and lectured on this phenomenon. In the process, vast areas of the tropics with soils similar to those found in the temperate regions were essentially ignored. Thus, tropical soils came to mean those soils high in sesquioxides which harden irreversibly on exposure. Latosols and lateritic soils erroneously became known as soils in the process of developing into laterite. Even relatively recent publications in widely read journals (*4*) conclude that most tropical areas, when cleared of vegetation, will become worthless brick pavement in a few years. We have known natural scientists to observe slightly weathered soils in temperate desert areas and refer to them as laterites because of their reddish color. Many such erroneous conclusions are based on the assumption that Buchanan (*5*) adopted the word laterite because of the red color of the soil, whereas he actually intended to refer to its use as building material.

In 1933, Hardy (*6*) emphasized that laterites have a limited areal extent in the tropics. Reliable estimates of soils that will harden into laterite on exposure are not available for the entire tropics. Regional estimates by soil scientists and calculations based on maps provide the following estimates of the areal occurrence of laterites: 2 percent for tropical America (*7*), 5 percent for central Brazil (*8*), 7 percent for the tropical part of the Indian subcontinent (*3*), 11 percent of tropical Africa (*3*), and 15 percent for sub-Saharan West Africa (*9*). On the basis of these and other estimates, we venture that the total area of the tropics in which laterite may be found at or close to the soil surface is of the order of 7 percent. Furthermore, laterite or plinthite occurs in predictable positions in certain landscapes, not only in the tropics but in the southeastern United States as well (*10*), and is developed in the subsoil. Marbut (*11*) observed that "In no single case was the horizon of iron concentration found on the surface where the local situation was not such as to make it clear that it had been exposed by erosion." The vast majority of the tropics, therefore, is not affected by this problem, and it is not even a problem unless the iron-enriched plinthite layer is exposed by erosion.

Nearly 20 years ago Carter and Pendleton (*12*) stated

> The concept of a tropical process came to be focused about the term "laterite." Laterite was and is a feature, a specific thing, and not a process. The process was invented by those who had never seen the feature and who, even worse, applied it to all sorts of phenomena supposedly, but not really like laterite as originally described.

In an attempt to confine laterite to its original definition the term plinthite, meaning iron-rich, humus-poor soil material which will harden on repeated wetting and drying, is now used in soil taxonomy (*13*).

Soil Organic Matter

The red color of soils in many tropical areas is in striking contrast to the color of soils in the cooler parts of the temperate zone. The immediate conclusion often made is that organic matter is lacking in tropical soils. However, comparing the organic carbon content of 16 randomly chosen, well-drained Mollisols, Alfisols, and Ultisols from the United States and the same number of similarly selected Oxisols, Alfisols, and Ultisols from Brazil and Zaïre, we found some major contradictions to common beliefs. The average organic carbon content in the top 1 meter was 1.11 percent for the black U.S. Mollisols and 1.05 percent for the red, highly weathered Oxisols. Mollisols and Oxisols are, respectively, the principal soils of temperate and tropical American grasslands. The gray-brown Alfisols from the United States contained 0.52 percent organic carbon, while the reddish tropical Alfisols contained 0.54 percent organic carbon. The reddish temperate Ultisols contained 0.40 percent organic carbon, and the reddish tropical Ultisols 0.66 percent (*14*). None of these differences in organic carbon content between tropical and temperate soils are agronomically or statistically significant. Although the organic matter content is low in many African soils, in general it is higher than that in soils of the southeastern United States or of U.S. desert areas of comparable mean annual temperature and rainfall.

This similarity between tropical and temperate soils can be understood in terms of the temperature and moisture regimes and the empirical rule that for every 10°C increase in temperature, the rate of biological activity doubles. In the temperate regions, low winter temperatures greatly reduce biological activity. In the 78 percent of the tropics that has a pronounced dry season of at least 90 days, the lack of moisture during this period has a similar effect. Topsoil and air temperatures during the tropical rainy seasons are similar to, but seldom as high as, the corresponding summer temperatures in the temperate regions. For the 22 percent of the tropical areas with heavy rainfall and no dry season, the explanation is somewhat different. Most of these areas are covered by tropical rain forests. Neither temperature nor moisture limits organic matter accumulation and decomposition at any time. These forests produce about five times as much biomass and soil organic matter per year as comparable temperate forests. The rate of organic matter decomposition, however, is also about five times greater than in temperate forests (*15*). Thus, the equilibrium contents are similar.

Soils of the Tropics

The tropics are by no means uniform climatically or in the distribution pattern of soils. Four major ecological zones can be distinguished: the savannas and associated grasslands, which cover approximately 49 percent of the land area; the evergreen forests, which cover 24 percent; and the desert and semidesert areas, which cover 16 and 11 percent, respectively (*16*). Approximately 23 percent of the tropics is more than 900 meters above sea level; these areas constitute the tropical highlands.

Within the confines of a single article, some generalization must accompany a discussion of a subject as broad as soils of the tropics. Assuming this risk, we will point out what we think are the major differences between soils in the tropical zone and then give some examples of the variations that are found within the major types.

Tropical savannas are a temptation to agronomic development because they can be easily cleared of vegetation and they are apparently underused at present. Extensive savanna areas occur in tropical America and Africa, with smaller areas in Asia and Australia, and a cursory overview indicates that similar soil-related problems would be encountered on all of them. A dry season of at least 3 months and annual burning are common in these savannas.

More detailed examination of the soils reveals that savannas in West and East Africa are generally well supplied with bases, while those of South America are generally almost devoid of bases. Variations in tropical America frequently result in the presence of semideciduous forests interspersed with the savannas in areas where parent rock is of basic composition and abundant bases are present in the soil.

Supplemental calcium and phosphate are almost always needed for range cattle in tropical America to prevent the occurrence of broken bones, since calcium and phosphorus are deficient in the soil and consequently in pastures. While few large mammals evolved in tropical America, vast herds of large mammals have evolved in Africa and on the temperate prairies. This suggests that the evolution of large mammals was precluded in the savannas of tropical America by the calcium and phosphorus deficiency of the soil. Projected agricultural development of these savannas will require greater attention to supplying bases than will similar development in Africa.

Densely forested parts of the tropics are frequently viewed as potentially viable agricultural areas. Proponents point to adequate rainfall and temperature conditions or, more naively, to the volume of biomass present. The soils in such areas vary widely. The density of the humid forest tends to show little response to soil conditions, although compositional variation is often related to soil variation. Depending on the composition of the parent material, soil conditions are very much like those in the forested areas of the nonglaciated temperate zone. Where the parent materials are acidic, the soils closely correspond to those of the southeastern United States and have the same problems of low cation retention, high acidity, and high exchangeable aluminum content. Where soils are derived from basic materials they tend to be less acid and frequently neutral in reaction. In all the forested areas the bulk of the available nutrient elements are bound in the biomass and tightly conserved in a closed nutrient cycle. Recent floodplain areas which receive additions of fertile sediment abound but are seldom contiguous for sufficient distances to support more than subsistence exploitation.

Shifting cultivation is common in many of these areas. Farmers utilize the nutritional accumulation of several years of biomass in hardy noncommercial species to fertilize 1 to 3 years of cultivated agriculture. Fire, used to clear the land, hastens the release of the organically bound nutrients, thus providing for the farmers' needs in rapid crop production.

Tropical deserts and semiarid areas with low total annual rainfall exist at all altitudes and over a wide range of temperatures. The soils are often quite fertile, and their only outstanding need is for irrigation systems to transmit water. There may be some salinity and alkalinity problems. These areas are sparsely populated except for the irrigated valleys, many of which support modern intensive agriculture.

Recent volcanic areas and steep slopes are sites of intensive subsistence cultivation in the tropical highlands. Although the processes of soil formation and many of the soil properties differ greatly, one common pedogenic principle prevails: the soil materials have not been subjected to intensive weathering. Therefore, these soils provide enough nutrients so that when a crop seed is placed in the ground it will grow. Erosion, detrimental in most areas, is frequently the mechanism of removing the more weathered, base-depleted mineral material from the soil surface and exposing less weathered material.

A better understanding of the similarities and differences between soils of tropical and temperate areas is needed for appraising their properties and for extrapolating management practices. This task has been greatly helped by the development of a natural soil taxonomy system (*2, 13*) akin to the better known plant and animal taxonomies. Soils can now be grouped and named according to their measurable properties, instead of the older classifications based on various soil genesis theories.

In this system, many similar temperate and tropical soils fall into the same classes through the fifth hierarchical level (the soil family), where soil temperature criteria separate them. Early observations—such as those of Marbut and Manifold (*17*), who asserted that the predominant soils of the Amazon Basin are similar to those of southeastern United States—can now be quantitatively proved (*18*). A more abbreviated system has been developed by the Food and Agriculture Organization of the United Nations (*19*) in preparation for the U.N.-sponsored world soil map. The nomenclature is somewhat different to accommodate different national preferences, but the effect is similar. It is possible now to have a reasonably well quantified estimate of the geographical extent of the main soils of the tropics based on small-scale maps (*20, 21*).

High Base Status and Low Base Status Soils

Agriculture in the tropics first developed in areas of high base status soils. These soils—now called Alfisols, Vertisols, Mollisols, and certain Entisols and Inceptisols (*13*)—cover approximately 18 percent of the tropical land area (*16*). The centers of population in the tropics are in areas having these soils. The impact of the Green Revolution programs is very much limited to areas with high base status soils, particularly those that are irrigated. These soils have generally developed from alluvium, sediments, or volcanic ash rich in calcium, magnesium, and potassium. They present slight to no acidity problems and therefore require practically no investment in lime. Nitrogen is the most commonly limiting nutrient. Phosphorus deficiency, micronutrient disturbances, and moderate salinity problems occur, but these can be corrected at low cost. In other words, high base status soils are almost synonymous with high native soil fertility and a relatively low cost of supplying additional nutrients.

A larger group of soils in the tropics are of low base status and are highly leached. They are now classified mainly as Oxisols, Ultisols, some Inceptisols, and sandy Entisols. They cover approximately 51 percent of the tropics (*16*) in vast areas in the interior of South America and Central Africa and smaller areas of the hill country of Southeast Asia. These soils are commonly deficient in bases and often present aluminum toxicity problems. Deficiency of phosphorus is often difficult to correct because phosphorus fertilizers react with iron and aluminum oxides and are fixed in slightly soluble forms. Micronutrient and sulfur problems are common. Correcting these nutritional problems usually involves substantial investments in fertilizer and lime. On the positive side, many of these low base status soils, especially the Oxisols, possess excellent physical properties which facilitate tillage and reduce erosion hazards. The fact that no great centers of population are found in these areas can be related to the infertility of such soils, as well as other factors. Similar soils, mainly the Ultisols, are found in the temperate region in areas such as southeastern United States and southeastern China, where they support large populations. They were intensively cropped after correction of their low fertility with manures, fertilizer, and lime.

A third major grouping consists of high base status soils called Aridisols, which occur in tropical deserts and occupy about 14 percent of the tropics. The availability of irrigation and nitrogen are the principle limiting factors. When properly irrigated, and thus free of salinity problems, these soils can become extremely productive.

A fourth group consists of shallow soils and dry sands, which occupy the remaining 17 percent of the tropical land mass.

Our discussion will be limited to the first two groups only, the third being the domain of irrigation specialists and the potential of the fourth being severely restricted.

There is no need to remind the reader of the dismal statistics on the subject of world food shortages. Massive food exports from the developed countries into famine areas should only be considered as short-run measures. In the long run, political and practical considerations dictate that developing countries must feed themselves. Is this likely to happen in the remainder of this century? Assuming significant gains in birth control, there is increasing evidence that, in certain tropical countries blessed with some high base status soils and cursed with vast areas of low base status soils, this is agronomically possible.

We submit two fundamentally different strategies to achieve this goal: intensive agriculture in high base status soils and extensive agriculture in low base status soils.

Intensive Production in High Base Status Soils

The productivity of high base status soils has been proved; for centuries they have supported dense human populations and large animals. Application of a technological package consisting of new high-yield varieties of wheat and rice, nitrogen fertilization, chemical weed and pest control, and very often irrigation has provided dramatic sustained increases in production (*22*).

The spread of the Green Revolution is very much limited to high base status areas of tropical Asia and tropical America. Further progress can be expected when high-yielding varieties of other cereals, grain legumes, and particularly root crops are developed. Soil management adaptations to future varietal breakthroughs are bound to be relatively straightforward. The value of the crops and land will probably justify substantial investments in fertilizer, in spite of the current high prices.

Research on more efficient use of nitrogen fertilizers, through either slow-release sources or improved manipulation of rates, placement, and timing of applications, is of high priority and has already produced significant results (*23*).

An intriguing possibility is to improve the intercropping systems practiced for centuries by subsistence farmers, in which a number of crops are grown at the same time in the same field. Such practices were regarded as primitive by agronomists and soil scientists until original research by Bradfield and associates (*24*) attracted international attention. The shift of the soil scientist's focus from supplying nutrients to a single crop to supporting two or more interacting root systems and harvesting two or sometimes four crops a year will require a major effort in fundamental and practical research. The first results of this effort show that certain intercropped systems use fertilizers much more efficiently and economically than would the separate crops grown on an equivalent area (*25*).

The food production increases in high base status soils will be limited by their relatively small area and already intensive exploitation. It is doubtful whether the world food crisis can be solved if development is limited to these soils.

Extensive Production in Low Base Status Soils

An appraisal by Kellogg and Orvedal (*26*) indicates that the vast tropical jungles and savannas constitute the largest block of potentially arable soils in the world. What has been done about them? The first research efforts, by European colonial governments in Africa, attempted to replace the seemingly primitive system of shifting cultivation by intensive mechanized farming similar to that of Europe. These efforts failed because of inadequate knowledge of both the physical and the social environment. Later efforts in Zaïre concentrated on rationalizing the pattern of land clearing, using corridors to preserve the ratio of years in crops and years in fallow essential for the maintenance of shifting cultivation (*27*). In sharp contrast, the state of São Paulo in Brazil has developed modern agricultural practices on low base status soils basically no different from the soils of Zaïre. Research in São Paulo (*28*) led to fertilizer, lime, and energy inputs similar to those used in the southeastern United States. These dramatically different approaches deserve some examination. The low base status soils of Zaïre, São Paulo, and the southeastern United States have similar limitations of high exchangeable aluminum contents, low phosphorus contents, and associated problems. Direct transfer of U.S. or European principles and practices to Zaïre and São Paulo was possible at experiment stations, where crop production exceeded that in the United States because of the year-round warm climate. In Zaïre, lack of transportation, industry and market infrastructure, and century-old social customs prevented their adoption. In São Paulo, adequate transportation, industry (including fertilizer production), markets, and sparse population permitted their adoption. The high levels of investments in fertilizer and lime paid handsomely in São Paulo.

With the advent of the protracted energy shortages and the continued high cost of petroleum and fertilizers, some modifications of the method applied successfully in São Paulo are needed. A strategy based on minimum inputs is gradually taking form within the tropical agronomy research community.

The first consideration is an awareness that shifting cultivation is an efficient soil management system, considering the resources farmers have at their disposal in sparsely populated forested areas (*29*). However, population pressures are reducing ratios of crop years to fallow years to the point where shifting cultivation is degenerating into a downward fertility spiral in many areas. The need for continuous cropping is acute and systematic research efforts are required. In the vast savannas of South America, where extensive cattle grazing is virtually the only form of agriculture, the opening of new roads and markets carries with it an infusion of new settlers. For example, within 10 years after the 1500-kilometer road between Belém and Brasília was constructed, 2 million people have settled along it. They are, however, dependent to a large extent on food transported from other areas.

A second consideration is that, instead of manipulating the soil to meet plant demands, the opposite strategy should be favored, that is, adapting plants to low base status soil conditions (*30*). Certain crop and pasture species are more tolerant than others to high levels of exchangeable aluminum, low levels of available phosphorus, and other soil problems. Examples of the more tolerant species are upland rice, cassava, sweet potatoes, cowpeas, and several grass and pasture legumes (*31, 32*). Significant differences in tolerance to these limitations are also known to exist between varieties of rice, wheat, dry beans, and soybeans (*30, 33*). Tolerant species and varieties evolved in low base status soils and thus are a result of natural adaptation to such conditions. These differences have been traced to specific genes in certain crops (*33*). Tolerance to exchangeable aluminum and low available soil phosphorus can become a major component of breeding programs. The nutritive value of these varieties, however, should be considered. Plant breeders and soil scientists working together on these problems should be able to produce more tolerant species with other desirable properties such as high yield potential and grain quality. As Jennings (*22*) commented, it is necessary to stop selecting future varieties under optimal soil, water, and pest control conditions.

There is increasing evidence for a quasi-symbiotic nitrogen fixation between bacteria that thrive in acid soils and certain varieties and species of tropical grasses. Döbereiner and Day (*34*) indicate that selection of species and varieties of such grasses could add a significant amount of nitrogen, when the conditions on which these organisms thrive are better understood.

Adaptation of crops to low base status soils cannot be viewed as a substitute for fertilizer applications. However, it would significantly decrease the quantity of fertilizer and lime needed to obtain optimum yields. The question that should be considered is what are optimum yields under these conditions. Economists and soil scientists are trained to consider an optimum yield as the point in the fertilizer response curve where the marginal revenue from an added yield equals the marginal cost of the last input of fertilizer. This concept may prove to be another casualty of the energy crisis.

In the areas we are considering land is relatively cheap, while the cost of fertilizer and its transportation from the factory to the farm are expensive. Optimum yields should be considered those which optimize the use of the scarce resources: fertilizers and other energy-based inputs. Maximum fertilizer efficiency is reached in the steep initial part of the fertilizer response curve. Marginal analysis, however, recommends fertilizer rates in the relatively flat later part of the curve. When the fertilizer response curve is represented by two straight lines, in the linear response and plateau model (*35*), the recommended rate is that at which maximum yield is attained at the point of maximum fertilizer efficiency. The rates recommended by the linear response and plateau model are usually lower than those recommended by marginal analysis. Considering the residual effect of many inputs, particularly lime, phosphorus, and some micronutrients, and the possibility of obtaining two or three crops a year in many of these areas, the use of lower fertilizer rates is not bound to decrease food production. Together with the use of adapted species and varieties, it represents an adjustment to the new economic realities and, in the long run, a means for conserving resources such as phosphates.

A third consideration is devising a means for increasing the efficiency of the fertilizer and lime that are applied. The use of methods for evaluating soil fertility, including soil tests, plant analysis, correlation studies, and interpretation, has substantially increased the efficiency of fertilization and liming in tropical America (*36*).

Many low base status soils have an extremely high capability to "fix" phosphorus in relatively insoluble forms. The quantities of water-soluble superphosphates needed to provide adequate yields are often uneconomical, unless ample credit is available to depreciate the cost as a capital investment for several years (*37*). Attention has recently been directed by the Tennessee Valley Authority and its cooperators toward direct application of water-insoluble rock phosphates (*23*). Many rock phosphates of high reactivity are soluble in acid soils, and are cheaper than superphosphates, because they are the raw materials from which the latter are produced.

In certain low base status Oxisols, silicates are applied commercially as fertilizer (*38*). The silicate anion reacts similarly to the phosphate anion in these soils, and thus silicates can also be fixed by iron and aluminum oxides. Although silicon is not officially accepted as an essential element for crops, favorable agronomic responses to silicon applications are known to occur in crops like sugar cane and rice (*38*). A further combination is also possible. Rock phosphates of low reactivity can be thermally fused with inexpensive magnesium silicate to provide a source of more soluble phosphorus with silica and other elements in it. These products were studied in the 1930's and 1940's in Europe and the United States, but were abandoned when they could not compete with superphosphates. The old literature is literally being pulled from the shelves and the findings adapted to these tropical soils. Research on these and other unconventional fertilizer sources, such as slow-release nitrogen products, is an exciting activity at many experiment stations in the tropics.

The concept of maximizing the efficiency of energy-related inputs in tropical areas is not necessarily limited to fertilizers. For example, research on land-clearing methods in the Amazon jungle indicates that the traditional slash-and-burn method with hand labor produced higher yields at a lower cost than does mechanized clearing with bulldozers (*39*). The main factors are the high cost of operating and maintaining machines in tropical rain forests and the free fertilizer obtained from the ash. Also, with smaller clearings the transition from shifting to continuous cultivation can be made gradually. Clearings of several hundred hectares, although attractive to development officials, create havoc for farmers when they have to cope with vigorous jungle regrowth, fertilizer shipments, and other severe management problems on a large scale. Very often such areas are eventually abandoned.

Prognosis for Increasing Food Production in the Tropics

We are cautiously optimistic that soils of the tropics can make a major and sustained contribution toward world food production when they are well characterized and understood and economically realistic management systems are used. Most of the improvements in the near future can be expected from increasing yields in the high base status soils, but in the long run the conquest of the low base status soils is the larger issue. Ongoing research projects in various regions of the tropics support these statements. Unlike classic plant breeding problems, many problems concerning soils are site-specific, and recommendations have to be compatible with practices at the local levels. Therefore, more sites are needed for practical soil management research. This was demonstrated at a recent seminar on soil management in Colombia (*40*), when a delegate from Nigeria recommended that burning should be eliminated in clearing tropical forests, while work in Peru demonstrated the dramatic fertilizing benefits derived from burning. This apparent discrepancy was explained by the fact that the ash raised the soil *p*H from 6 to 8 in Nigeria, causing iron deficiency, while in Peru the ash raised the soil *p*H from 4 to 4.5, supplying needed bases to the soil.

Pronouncements concerning the effectiveness of soil-related practices have to be carefully evaluated according to soil properties. A single tropical soil elixir is not available.

Summary

The properties and potential of soils of the tropics are poorly understood. The old idea that laterite is formed when tropical soils are cleared is true of only a small proportion of the area. In most features, soils in the tropics are similar or equivalent to soils in the temperate regions. Specifically, soil organic matter contents, commonly believed to be low in the tropics, are essentially similar to those of the temperate regions. While the basic concepts about physical and chemical behavior developed in the nonglaciated temperate regions are directly applicable to the tropics, the development of soil management practices for sustained food production involves different strategies because of environmental and economic constraints. A major distinction is made between the development of high base status and low base status soils. With the former, soil management practices should be aimed at maximizing the potential of high-yielding varieties and improving intercropping systems with relatively intensive fertilizer inputs. With the low base status soils of the vast savanna and jungle areas energy-related inputs should be optimized by (i) selecting of crop varieties and species more tolerant to nutritional deficiencies or toxicities, (ii) applying fertilizers at lower rates than those recommended by classic marginal analysis, and (iii) increasing the efficiency of applied fertilizers in such soils.

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Low-Input Cropping for Acid Soils of the Humid Tropics

PEDRO A. SANCHEZ AND JOSE R. BENITES

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Low-Input Cropping for Acid Soils of the Humid Tropics

Pedro A. Sanchez and Jose R. Benites

A low-input cropping system has been developed at Yurimaguas, Peru, to serve as a transition technology between shifting and continuous cultivation for acid soils of the humid tropics. Principal features are slash-and-burn clearing, rotation of acid-tolerant upland rice and cowpea cultivars, maximum residue return, no tillage, and no lime or fertilizer applications. When yields decline as a result of increasing weed pressure and nutrient deficiencies, a kudzu fallow is grown for 1 year. Subsequent options include fertilizer-based continuous cultivation, pastures, or agroforestry. The system preserves some agroecosystem diversity and contributes toward a sustainable level of production and income for farmers in humid tropical regions.

STABLE ALTERNATIVES TO SHIFTING CULTIVATION ARE NEEDed for humid tropical locations where increasing demographic pressure no longer permits traditional slash-and-burn agriculture. In previous articles we have given an overall appraisal of soils of the tropics (*1*) and described fertilizer-based continuous cultivation technology as one soil management option (*2*). Subsequent research in the Amazon of Peru and Brazil has shown promise for an array of management options for humid tropical landscapes dominated by acid soils. Some of these options, shown in Fig. 1, are applicable to specific combinations of topography, soil type, and level of socioeconomic infrastructure development (*3, 4*). Acid soils, classified mainly as Ultisols and Oxisols, cover approximately two-thirds of the world's humid tropics (*5*). Differing management options have been developed for high base status, nonacid Alfisols and Andisols of the tropics where the subsoil is rich in bases that can be recycled (*6, 7*). In either acid or nonacid soils, evidence shows that continuous production of food crops is possible in the humid tropics with judicious use of lime, fertilizers, crop rotations, and soil conservation practices (*2, 6, 8, 9*). But it is unlikely that the majority of shifting cultivators in the humid tropics can readily switch to continuous production systems because of market infrastructure limitations. Intermediate systems of low-cost and low-input technologies might be useful as a first step to more permanent land use.

Low- Versus High-Input Approaches

Agronomists disagree about the use of the terms "high-input" or "intensive" systems on one side, and "low-input," "minimum-input," "zero-input," "alternative agriculture," and "resource-limited" systems on the other. For soil management purposes, high-input systems have been defined as those that aim to eliminate soil constraints to crop growth by appropriate levels of liming, fertilization, irrigation, or other purchased inputs (*10*). A large percentage of the world's food supply is produced according to this approach, both in the developed world and in the more fertile lands of the developing world. Conversely, low-input systems for acid soils are defined as the cultivation of plant species adapted to the main soil constraints, to minimize but not eliminate purchased inputs, and to maximize nutrient recycling (*10*). Low-input systems are therefore different from zero-input systems, such as the effective nutrient cycling that exists between native forests and acid tropical soils (*11*). Such zero-input systems operate as long as there is zero output away from the field, which is what happens in undisturbed natural systems. When farmers remove nutrients in their crop harvests, they tend to deplete available nutrient stocks and induce nutrient deficiencies in plants. In naturally fertile soils this process may take years, but in acid Oxisols and Ultisols it takes months (*12*). Nutrients removed by harvests must be replenished in order to have sustained production. Nutrients can be replenished by biological nitrogen fixation, lime, fertilizer applications, and organic inputs such as mulches or manures brought from outside the field. With the exception of biological nitrogen fixation, the other means involve direct cash or labor inputs, such as the purchase of fertilizers and their application costs, or the gathering, transport, and application of organic inputs. The low-input approach aims at minimizing but not necessarily eliminating the need for inorganic and organic inputs from outside the field.

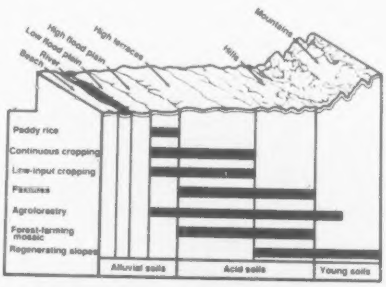

Fig. 1. Some soil management options for humid tropical landscapes dominated by Oxisols and Ultisols. [Reprinted from (*3*) with permission of the Management Entity, School of Agriculture and Life Sciences, North Carolina State University]

The authors are soil scientists with the Tropical Soils Research Program, Department of Soil Science, North Carolina State University, Raleigh, NC 27695.

Perspectives of Farmers

In 1982 a group of North Carolina State University and Peruvian scientists interviewed shifting cultivators around Yurimaguas, Peru, a humid tropical area with a mean annual temperature of 26°C, annual rainfall of 2100 mm without a pronounced dry season, an elevation of 182 m, predominantly acid soils, tropical rain forest vegetation, and a shifting cultivation system in disequilibrium because of rapid population growth (*13, 14*). When asked what their most important agricultural wish was, the farmers' most common reply was "to grow a second crop of upland rice before abandoning the land." Rice (*Oryza sativa*) is the main cash crop of the region. After one harvest the land either reverts to forest fallow or is planted to cassava (*Manihot esculenta*) or plantain (*Musa paradisiaca*) and eventually fallowed. When asked what farmers perceived as the major impediment for growing a second rice crop, the answer was weed control. One farmer also indicated that a tropical kudzu (*Pueraria phaseoloides*) fallow could be an alternative to the secondary forest fallow. Armed with these perceptions and experience on how to grow crops continuously with appropriate fertilizers (*12*), scientists in the Tropical Soils Research Program began to design a low-input cropping system.

Selecting Acid-Tolerant Germplasm

The first step in the research program was to identify sufficiently acid-tolerant species and varieties that would produce acceptable yields without liming. Field research was conducted at the Yurimaguas Experiment Station. The soils used are fine-loamy, siliceous, isohyperthermic Typic Paleudults. They are well-drained, acid (*p*H values between 4.0 and 4.5, topsoil aluminum saturation ranging from 50 to 80%), and low in native fertility (*13*). Germplasm believed to have high yield potential under humid tropical conditions was collected from different countries and then tested in limed and nonlimed plots at aluminum saturation levels of 20 and 80%, respectively (*15*). Cultivars were considered highly tolerant if their yields in acid soils were 85% or more of those obtained in the limed plots. In addition, the absolute yields had to be agronomically attractive. The overall results indicate a high degree of acid tolerance in upland rice and cowpea (*Vigna unguiculata*), an absence of acid tolerance in the maize (*Zea mays*), soybean (*Glycine max*), and winged bean (*Psophocarpus tetraglobulus*) germplasm tested, and evidence of moderate tolerance in peanuts (*Arachis hypogaea*) and sweet potatoes (*Ipomoea batatas*) (*15*). We selected an upland rice-cowpea rotation, using germplasm from the International Institute of Tropical Agriculture in Nigeria, as the basis for the low-input cropping system. The acid tolerance of the selected cultivars, Africano Desconocido rice and Vita 7 cowpeas, has been confirmed in a wide variety of trials and farmers' fields in the Peruvian Amazon.

Table 1. Productivity of a low-input cropping system with cultivars (cv.) of seven crops during the first 34 months after cutting and burning a secondary forest at Yurimaguas, Peru.

Chronology			Grain yield (ton ha^{-1})	
Crop sequence	Planting date	Harvest date	Not fertilized system	Fertilized* system
Rice cv. Carolino	1 September 1982	17 January 1983	2.4	2.4
Rice cv. Africano	11 February 1983	11 June 1983	3.0	3.1
Cowpea cv. Vita 7	7 September 1983	11 November 1983	1.1	1.2
Rice cv. Africano	15 December 1983	23 April 1984	2.8	3.2
Cowpea cv. Vita 7	9 May 1984	23 July 1984	1.2	0.9
Rice cv. Africano	5 September 1984	2 January 1985	1.8	2.0
Rice cv. Africano	26 February 1985	30 June 1985	1.5	2.5
Total			13.8	15.3

*Fertilizer was applied only to the four Africano rice crops.

The First Cropping Cycle

One hectare of Ultisol with a topsoil clay content of 28% and a 10-year-old secondary forest fallow was slashed on 15 July 1982, allowed to dry, and burned in the traditional manner on 20 August 1982. Previous studies demonstrated that traditional slash and burn is the best land-clearing method (*16*). The entire hectare was planted to the Carolino upland rice variety and grown by traditional shifting cultivation. After the first harvest, the field was split in half, and a low-input trial was initiated with the Africano Desconocido rice variety. Half the field was not fertilized, whereas the other half received an application of 30 kg of nitrogen, 22 kg of phosphorus, and 48 kg of potassium per hectare when Africano rice was grown. After the burning, a total of seven crops, five of rice and two of cowpeas, were harvested during a period of approximately 34 months. No tillage or lime was used, and all crop residues were evenly distributed to the field. Commercially available herbicides (*17*) and manual labor were used to control weeds. System chronology is shown in Table 1. The seven crops occupied the land for 76% of the time. The average time interval between crops was 39 days, reflecting the field-size plots, farmer timing, and labor availability. The experimental design was considered to be completely randomized; ten crop yield and soil sample replicates were taken per treatment (*18*).

Yields of the seven continuous crops harvested within 3 years are shown in Table 1. A total of 11.5 ton ha^{-1} (measurements in metric tons throughout) of rice and 2.3 ton ha^{-1} of cowpea grain was produced without any fertilizer or lime additions on this soil, which had a *p*H of 4.5. The only purchased chemical inputs were locally available contact herbicides and insecticides. Similar results have been obtained in six other replicated trials at the Yurimaguas Station during the last 5 years. Such results contrast sharply with our experience with intensive cropping systems where crop yields approached zero if the soil was not limed or fertilized within 1 year (2). The use of aluminum-tolerant cultivars, maximum residue return, and zero tillage are believed to be responsible for this difference.

Essentially, no responses to the fertilizer applications to the Africano rice crops were observed during yields of the first six crops (Table 1). Both upland rice and cowpea yields are considered high, in contrast to the regional average of about 1 ton ha^{-1} for upland rice and about 0.3 ton ha^{-1} for cowpeas. A sharp yield response to fertilizer was observed in the seventh crop, rice (*19*).

Soil properties. Topsoil chemical properties indicate favorable changes from 3 to 11 months after burning in response to the nutrient value of the ash, particularly in increasing base status (Table 2). From 11 to 35 months little change in topsoil *p*H, organic matter, and exchangeable bases took place. There was a slight decrease in soil organic matter content, in contrast to the 25% decrease observed in similar soils under high-input systems at the same location (*2*). Residue return and absence of tillage are probably responsible for this less drastic decline.

By the 35th month there were significant decreases in available phosphorus and potassium, which reached values below their critical levels for the site, 12 mg dm^{-3} for phosphorus and 0.15 cmol dm^{-3} for potassium (Table 2). Nutrient additions in the fertilized plots, however, were apparently sufficient to offset this decrease. We assume, therefore, that the supply of nutrients for this system could be sustained by modest fertilizer applications.

Nutrient removal and cycling. The calculated nutrient accumulation by the seven crops (Table 3) is based on nutrient composition of Africano rice and Vita 7 cowpea grain, stover, and roots obtained in neighboring experiments (*20, 21*). Even though only the rice grain and cowpea pods were exported from the field, these harvested products represented considerable nutrient removals from the field during the 3-year period. The amounts of nutrients accumulated by the crops but returned to the soil as above- or below-ground organic inputs were larger than the amount removed, except for phosphorus. Crop residues plus root turnover returned to the soil 62% of the dry matter produced, 54% of the nitrogen, 70% of the magnesium, 89% of the potassium, 95% of the calcium, but only 38% of the phosphorus accumulated by crops. If we assume there was 100% fine root decomposition (*21*), root turnover accounted for a relatively minor proportion of amounts recycled. The actual amounts returned, therefore, are equivalent to an annual fertilization rate of 98-7-199-33-13 kg ha^{-1} of nitrogen, phosphorus, potassium, calcium, and magnesium, respectively. A proportion of the nitrogen returned as aboveground residue, however, may be lost, by denitrification on the mulch-soil surface interface, before it enters the soil. Biological nitrogen fixation by cowpeas may counteract such losses, but neither process was measured. Other nutrient inputs are likely to be transferred entirely to the soil. Phosphorus, therefore, appears to be the critical nutrient, since about two-thirds of the crop uptake was removed by the harvested products, giving this element the lowest recycling percentage and the lowest absolute amounts returned to the soil among the five nutrients evaluated.

Weed pressure. In our view, increasing difficulty of weed control was the single most important factor for the instability of this low-input system during its third year. The initial weed population was mainly broad-leaved, which is typical of shifting cultivation fields in the area. With time, the weed population gradually shifted to more aggressive grasses not subject to economically sound control by commercially available herbicides (*16*). Of particular importance was the spread of ***Rottboelia exaltata***, a nonrhizomatous grass, particularly during rice growth. Cowpeas were more competitive with weeds than upland rice because they covered the soil surface more thoroughly.

Studies on weed control in low-input systems at Yurimaguas indicate that the absence of tillage and burning promotes weed buildup (*16*). Rice straw mulch may reduce weed growth in cowpeas, but cowpea residues do not have the same effect on rice, perhaps because of the fast decomposition rate of cowpea residues. Mt. Pleasant (*17*) concluded that six crops is a realistic estimate of the duration of the upland rice-cowpea low-input system in terms of economically sound weed control in Yurimaguas.

Economics. The summary of cost records in this 1-ha experiment for the first seven crops in the plots without fertilization is shown in Table 4. Labor inputs for the first crop include land clearing; thus the subsequent crops average half of the first crop's labor. Returning and redistributing crop residues averaged 10 man-days ha^{-1}, or approximately U.S.$20 per hectare per crop. Another major labor input was that of boys who were hired to keep the birds away from the crops near harvest time. The next major cost items were interest on crop loans from the agrarian bank and government fees for receiving and processing rice at the mills. Shifting cultivators routinely obtain bank loans that are used primarily as an advance on their labor. Interest charges fluctuating from 40 to 101% on an annual basis in local currency reflect the high inflation rate in Peru, which averaged 125% annually during the study period. Even in U.S. dollar terms the indirect costs averaged about 30% of the total production costs. In contrast, the cost of purchased chemical inputs (herbicides and insecticides) and other items (seed, bags, and thresher rent) comprised 8 and 19% of the total production costs, respectively. Since most shifting cultivators have no title to the land they use, no land costs were included in this estimate.

The low-input system without fertilizer applications was highly profitable, averaging net returns of U.S.$1144 per hectare per year or a 121% return over total costs (Table 5). The low-input system with fertilizers was also quite profitable, averaging an annual net return of U.S.$1125 per hectare and a 100% return over total costs. Fertilizers accounted for 9% of the total cost in the system, and also resulted in additional labor, interest, thresher use, and transport costs. The low-input system either with or without fertilizers was more profitable than traditional shifting cultivation (Table 5).

Transition to Other Systems

This low-input system, therefore, is a transitional technology in both agronomic and economic terms. After 3 years, the field is devoid of felled logs and most of the remaining tree stumps are sufficiently decomposed to be destroyed easily. The land-clearing process is thus complete, providing several options to the farmer, such as the following: (i) to put the land into a managed fallow and then start a second cropping cycle; (ii) to plow, lime, fertilize, and rotate crops intensively; (iii) to establish pastures; and (iv) to use an agroforestry system.

The experiment described above was modified to address some of these options after the seventh crop harvest in July 1985. The 1-ha

Table 2. Topsoil (0 to 15 cm) fertility dynamics within the first 35 months of the low-input cropping system on an Ultisol at Yurimaguas, Peru. Mean of 50 samples per treatment. The coefficients of variation (CV) were as follows: *p*H, 6%; Al, 46%; Ca, 46%; Mg, 41%; K, 43%; ECEC, 9%; Al saturation, 37%; available P, 39%; and organic matter, 20%. Comparisons for least significant differences (LSD) and CV do not include sampling at 3 months after clearing. ECEC, effective cation and exchange capacity.

Months after burning	Fertilized	*p*H (H_2O)	Exchangeable (cmol dm^{-3})				ECEC (cmol dm^{-3})	Al saturation (%)	Available P (Olsen) (mg dm^{-3})	Organic matter (%)
			Al	Ca	Mg	K				
3	No	4.4	1.10	0.30	0.09	0.13	1.62	68	20	2.12
11	No	4.6	1.46	0.92	0.28	0.19	2.85	51	13	2.06
	Yes	4.7	1.14	0.97	0.27	0.19	2.58	45	18	2.07
35	No	4.6	1.65	1.00	0.23	0.10	2.99	53	5	1.92
	Yes	4.6	1.23	1.16	0.20	0.16	2.76	44	16	1.77
LSD*		0.1	0.25	0.17	0.04	0.03	0.20	7	2	0.15

*The LSD are for comparing two sampling dates within a treatment at $P = 0.05$.

Table 3. Total dry matter and nutrient accumulation by five rice and two cowpea crops harvested in 35 months without fertilization.

Plant parts	Dry matter* (ton ha^{-1})	N	P	K (kg ha^{-1})	Ca	Mg
Grain and pods	14.2	250	34	73	5	18
Straw or stover	18.1	232	15	565	80	35
Roots	5.2	63	6	44	18	5
Total	37.5	545	55	682	103	58

*Based on mean grain:straw ratios of 0.84 for rice and 0.52 for cowpea; mean cowpea pod weight of 0.032 ton ha^{-1} per crop, and fine root biomass of 0.65 and 0.97 ton ha^{-1} per crop for rice and cowpea in the top 30 cm of soil (*20, 21*).

field was divided into eight 1250-m^2 plots, providing four treatments in a randomized complete block design with two replications. The replicates were located on the previously fertilized and unfertilized treatments in order to block the residual effects. Two treatments were designed to test the weed control factor by continuing the low-input system (cowpea-rice-cowpea); a third was planted to kudzu fallow, and the fourth was planted to a high-input system.

Continuing the low-input system. Previous crop yields suggested that the system collapsed after the seventh crop (Table 1). This observation was confirmed by growing three more crops with a weed control variable: full weed removal at economically unrealistic levels versus the conventional treatment. The full treatment consisted of eliminating weeds by a preemergence application of 2.25 kg ha^{-1} of the active ingredient of metolachlor plus 2.5 liter ha^{-1} of paraquat, followed by 0.28 kg ha^{-1} of the active ingredient of sethoxydim, supplemented by handweeding as needed. The actual cost of this treatment was U.S.$225 per hectare per crop, an unrealistic level. The conventional treatment was the preemergence application of 1.5 liter ha^{-1} of 2,4-dichlorophenoxy acetic acid followed by 2.5 liter ha^{-1} of paraquat 5 days later, and no handweeding, with a total cost of $25 per hectare per crop. Both weed control plots received the same application of fertilizers to rice as stated previously, in order to eliminate phosphorus and potassium deficiencies.

Grain yields of the eighth, ninth, and tenth consecutive crops under conventional weed control were low with cowpeas, and practically zero with rice (Table 6). When weeds were totally removed, yields of the ninth (rice) and tenth (cowpea) crops reached acceptable levels. Consequently, it seems that the collapse of the system is directly related to weed control problems.

Kudzu fallow and a second crop cycle. Traditional shifting cultivation involves a secondary forest fallow period of 4 to 20 years, supposedly to replenish soil nutrient availability and control weeds, although the processes involved are not well understood (*20*). Farmer experience around Yurimaguas indicates that a minimum desired age of fallow is about 12 years, but population pressures effectively reduce this period to an average of 4 years (*14*). Slashing and burning young forest fallows result in faster grass weed invasion than would occur in older fallows because the weed seed pool declines with age (*22*). Considering the limited likelihood of long secondary fallow periods in humid tropical areas in developing countries, the need for an improved fallow is apparent. Following a farmer's suggestion, Bandy and Sanchez (*23*) studied the use of tropical kudzu (*Pueraria phaseoloides*) as a managed fallow. Unlike its temperate-region counterpart (*Pueraria lobata*), tropical kudzu does not produce storage roots and therefore is easy to eradicate by slash and burn. Kudzu fallows were grown in previously cultivated fields. In the most infertile and compacted soils of Yurimaguas, kudzu is slow to establish and initially shows several classic nutrient deficiency symptoms, but within 3 months a complete canopy is attained, the kudzu leaves become dark green, and weeds are smothered. Aboveground dry matter and ash biomass accumulation by kudzu peaks at about 2 years (*23*).

The same kudzu ecotype was seeded in this low-input experiment, on 28 August 1985, after harvesting the seventh rice crop, which was heavily infested with *Rottboellia exaltata* and other weeds. No fertilizers were added to the kudzu plots, but the tall *Rottboellia* plants were handweeded one time. As before, kudzu was slow in establishing, but within 3 months it had developed a complete ground cover and a surface litter layer. Kudzu was slashed with machetes on 13 September 1986; after 10 days of dry weather, it was burned in a total time of 4 minutes for the 1250-m^2 plots. Ash sampled 1 day after the burn contained considerable amounts of nutrients, which were incorporated into the soil by the first rains.

Africano rice was planted 3 days after the kudzu burn and harvested on 22 January 1987. It received the 30-22-40 kg ha^{-1} of nitrogen, phosphorus, and potassium just as the previous rice crops. Grain yields were the highest obtained to date at this site (3.9 ton ha^{-1}). These yields were partly due to favorable rainfall distribution

Table 4. Labor input, production costs, and revenues incurred in the low-input system with seven crops without fertilization.

Labor, costs, and revenues	Crop sequence						
	Rice	Rice	Cowpea	Rice	Cowpea	Rice	Rice
Labor (man-day ha^{-1})	172	79	99	79	99	79	79
Cost (U.S.$ ha^{-1})							
Labor	380	140	113	134	167	130	95
Herbicides	21	21	25	26	25	24	25
Insecticides	0	11	14	14	13	0	0
Seed	19	17	75	18	51	16	17
Bags	16	18	8	20	7	18	50
Thresher rent	0	34	0	38	0	34	80
Transport to market	12	12	14	14	14	12	14
Loan interest and fees	135	80	86	105	108	111	225
Total cost	583	333	335	369	385	345	506
Revenue							
Grain produced (ton ha^{-1})	2.44	2.99	1.10	2.77	1.19	1.84	1.52
Price (U.S.$ ton^{-1})	321	281	1420	305	1127	265	274
Gross revenue (U.S.$ ha^{-1})	783	840	1562	845	1341	488	416
Net return (U.S.$ ha^{-1})	200	507	1227	476	956	143	−90
Net return/cost (%)	34	152	366	129	248	41	−18

for rice growth, as evidenced by similar rice yields obtained in other experiments at that time, but they were also a result of the absence of significant weed pressure. The 1-year kudzu fallow therefore effectively suppressed weed growth in a way far superior to the herbicide combinations attempted to date. A subsequent crop of upland rice was grown without any fertilization, and it averaged 1.9 ton ha^{-1}, an adequate yield for the time of planting.

Changes in topsoil chemical properties in the kudzu fallow plots at the end of the first cropping cycle, after 1 year of kudzu fallow (1 day before burning), and after the first harvest of the second cropping cycle are shown in Table 7. The effect of the kudzu fallow on topsoil chemical properties includes a significant decrease in exchangeable calcium and potassium, presumably owing to plant uptake, with no changes in acidity, aluminum saturation, or available phosphorus. Topsoil properties at 54 months after burning, representing seven crop harvests, 1 year of kudzu fallow, and one crop harvest afterward are as good or better than 3 months after burning the original forest (Table 2). Topsoil organic matter contents have increased, probably as a result of the kudzu fallow litter inputs. The second cropping cycle is being continued in order to determine how long these effects will last; however, in this cycle no additional fertilizer is being applied, and weed control will be only at the conventional level.

High-input crop production. Another option is for the low-input system to serve as a 3-year transitional period to intensive, fertilizer-based, continuous cropping systems for areas that have developed a sufficient road, credit, and market infrastructure to make this possibility attractive. In these areas the fields are ready for mechanized tillage, provided that slopes are suitable, because most of the felled vegetation has decomposed. One treatment of this field experiment was tilled to 25 cm with a 50-hp tractor, limed and fertilized according to soil test levels and previous experience, and planted to a maize-maize-soybean rotation. Maize yields were normal for high-input systems for the planting season (3.9 and 2.9 ton ha^{-1}) (*24*), whereas soybean yields were slightly lower than normal (1.9 ton ha^{-1}). The system appears stable and of similar productivity to long-term high-input systems grown at Yurimaguas (*2, 25*). A combined total of 8.6 ton ha^{-1} of high-value grain (maize plus soybeans) was produced in approximately 15 months. Total productivity of the entire sequence was 22.4 ton ha^{-1} of grain in 4 years and 4 months, or 5.2 ton ha^{-1} per year. In order to decrease weed infestations, it may be advisable to use the kudzu fallow before shifting to high-input cropping.

Legume-based pastures. Pastures for beef and milk production are an attractive option in the Latin American humid tropics and one in particular need of improved technology because of widespread pasture degradation. The low-input system can also serve as a precursor to establishing improved, acid-tolerant pastures, beginning with the clearing of secondary forests. Income-generating food crops can be grown, and the pasture species may be planted either vegetatively or by seed under a rice canopy. Several combinations of persistent, acid-tolerant grasses and legumes have produced high and sustained live-weight gains of the cattle in Yurimaguas for 6 years (*26*). The kudzu fallow itself could be used as a pasture in rotation with grass-based pastures. Since weed encroachment is a major limiting factor in pasture establishment, it may be advantageous to limit the number of crops to minimize the weed buildup that occurs during the sixth and seventh crops. Planting kudzu fallow, burning it after 1 year, and then establishing the pastures may be a better approach.

Agroforestry. The low-input cropping system is a good way of providing cash income and ground cover during the establishment phase of tree plantations. The decision, however, has to be made early in order to plant the tree crops shortly after clearing and burning the secondary forest. Unless liming is contemplated, the choice of tree crops should be limited to acid-tolerant ones. Examples of acid-tolerant crops for industrial purposes are rubber (*Hevea brasiliensis*), oil palm (*Elaeis guineensis*), and guarana (*Paullinia cupana*); for food production, peach palm (*Bractis gasipaes*); for alley cropping, *Inga edulis*. Woody species known to be sensitive to soil acidity, such as *Theobroma cacao* and *Leucaena leucocephala*, should be avoided.

The low-input system has been used successfully in nearby experiments for the establishment of peach palm and multipurpose tree production systems that include fast-growing (*Inga edulis*) and slow-growing (*Cedrelinga cataeniformis*) species (*27*). For peach palm, seedlings are transplanted with the first rice crop. Within 18 months, the peach palm produces too much shade for further crop growth; kudzu is then planted as an understory (*28*).

Although agroforestry systems are generally believed to be soil-protecting, most trees develop a full crop canopy much more slowly than annual crops (*29*). Consequently, a rapidly established ground

Table 5. Cumulative production costs and returns incurred with seven crops in 3 years in the low-input system with and without fertilization and under shifting cultivation.

Costs and revenues	Low-input system				Shifting cultivation	
	Not fertilized		Fertilized			
	U.S.$ ha^{-1}	Percent	U.S.$ ha^{-1}	Percent	U.S.$ ha^{-1}	Percent
Cost						
Labor inputs	1159	41	1185	36	380	65
Chemical inputs						
Fertilizers	0	0	292	9	0	0
Herbicides	167	6	167	5	21	4
Insecticides	39	2	27	1	0	0
Other inputs						
Seed	213	7	213	6	19	3
Bags	137	5	140	4	16	3
Thresher use	186	7	189	5	0	0
Transport to market	92	2	96	3	12	2
Loan interest and fees	850	30	1017	31	135	23
Total cost	2843	100	3326	100	583	100
Revenue						
Gross revenue	6275		6688		783	
Net return	3432		3362		200	
Net return/cost		121		101		30

cover is highly advantageous in the humid tropics. This can be achieved by the acid-tolerant, low-input cropping or by establishing acid-tolerant, legume ground covers.

Ecological Implications

The low-input system has several potentially positive environmental impacts. It provides a low-cost alternative for shifting cultivation in highly acid soils. To produce the grain yields reported in Table 1, a shifting cultivator would need to clear about 14 ha in 3 years, in comparison to clearing 1 ha once, by means of the low-input system. Furthermore, the use of secondary forest fallows instead of primary forests is emphasized, although the system should work well starting from primary forest.

Erosion hazards are largely eliminated by the absence of tillage and the presence of a plant canopy on the soil surface, be it slash-and-burn debris, crop canopies, crop residue mulch, or a managed fallow. Nutrient recycling is maximized, but nutrients exported as grain must be replenished by outside inputs in soils low in nutrient reserves. Perhaps just as importantly, the low-input system does not lead the farmer into a corner; it provides a wide range of options after the first cropping cycle is complete.

Current Research

Although the feasibility of the low-input cropping system during the first cropping cycle followed by a managed fallow period has been demonstrated, information about the second cropping cycle is limited to two crop harvests. It cannot be stated at this point that a modified form of shifting cultivation with a 3:1 crop to managed fallow ratio is feasible on a long-term basis. More in-depth knowledge of weed population shifts and fertility dynamics is needed. Zero tillage poses a major constraint to long-term weed control. Soil data have been confined to readily determined chemical parameters; the physical and biological dynamics of soil are being intensively studied now. Tropical kudzu is but one of several promising species for managed fallows, and others are being investigated in terms of above- and below-ground biomass accumulation, nutrient cycling, and weed suppression (*30*). The management of organic inputs and soil organic matter is being researched (*31*).

The effect of age of fallow also needs to be studied in greater detail. What are the tradeoffs with a longer fallow? Can the weed problem be reduced by shortening the time period between harvesting and planting? A 39-day average interval allows plenty of time for weed regrowth.

The nutrient recycling aspects seem to be working well except for possible inefficiencies in nitrogen. Denitrification losses from residues left on the soil surface need quantification; the nitrogen loss by burning a kudzu fallow must be considerable. Biological nitrogen fixation by cowpeas and kudzu may counteract this effect, but its extent has not been quantified. Even though this Ultisol is not classified as a high-phosphorus fixer (*12*), this element is the least recycled because of grain export. Phosphorus fertilization will likely be needed. Other nutrients, however, may be more critical in different soils.

Limitations of the Study

We have demonstrated the agronomic and economic feasibility of this transition technology at Yurimaguas. Its basic components (slash-and-burn clearing, acid-tolerant cultivars, zero tillage, maximum residue return, minimum fertilization, and weed eradication by managed fallows) may be applicable in much of the humid tropics, but the choice of crop species and varieties, managed fallows, and duration of the system are probably site-specific. When the system was replicated at a sandier site in Yurimaguas, the cropping period was reduced from seven to five crops. The difference between the soils is only topsoil texture (loamy sand versus sandy loam), and they are otherwise identical at the family level of soil taxonomy. The Fertility Capability Classification system (*32*), however, did distinguish between these two soils at the highest categorical level. This technical soil classification system could be helpful in identifying soil constraints that may affect the performance of low-input cropping systems in other soils.

Table 6. Grain yields of three additional crop harvests in the low-input system at two levels of weed control. NS, not significant.

Crop sequence	Planting date	Harvest date	Weed control level		LSD ($P = 0.05$) (ton ha^{-1})
			Conventional (ton ha^{-1})	Full (ton ha^{-1})	
Cowpea cv. Vita 7	19 August 1985	31 October 1985	0.58	0.58	NS
Rice cv. Africano	9 January 1986	9 May 1986	0.09	1.60	0.19
Cowpea cv. Vita 7	15 July 1986	25 September 1986	0.43	0.82	0.26

Table 7. Changes in selected topsoil (0 to 15 cm) chemical properties before and after 1 year of kudzu fallow and after harvest of subsequent crop. Plots did not receive fertilizers during the first cropping cycle. The CV were as follows: *p*H, 4%; Al, 25%; Ca, 35%; Mg, 32%; K, 9%; Al saturation, 21%; available P, 48%; and organic matter, 15%.

Plot status	Months after burning	*p*H (H_2O)	Exchangeable (cmol dm^{-3})				Al saturation (%)	Available P (Olsen) (mg dm^{-3})	Organic matter (%)
			Al	Ca	Mg	K			
End of first cropping cycle (seven crops)	35	4.5	1.9	0.98	0.10	0.26	50	4	1.92
After 1 year of kudzu fallow (before burning)	52	4.5	1.8	0.60	0.09	0.13	68	7	
At first harvest of second cropping cycle	54	4.8	1.6	1.05	0.18	0.23	52	14	2.44
LSD ($P = 0.05$)		0.2	0.3	0.25	0.05	0.05	11	6	NS

Germplasm selection for acid tolerance continues at Yurimaguas (*33*). The most promising results are with acid-tolerant grain sorghums selected by Gourley and Flores (*34*). Selection continues with upland rice, particularly for high grain quality and milling percentage, attributes deficient in the prototype variety, Africano Desconocido. Selection for cowpea cultivars that develop a closed canopy in less time than the present ones is also desirable. Breeding for acid soil tolerance of maize, soybeans, and other important tropical crops that are acid-sensitive is being carried out throughout the world.

Low-input cropping is viable when initial conditions are favorable in terms of nutrient inputs from the ash and low-weed pressure found in a 10-year-old secondary forest. This system is unlikely to perform as well in nutritionally depleted, compacted, or weedy soils that are a product of mismanagement. The duration of the cropping period is probably a function of initial soil conditions and of processes related to fertility depletion and weed populations. A network of validation trials throughout the humid tropics, with the use of locally adapted cultivars, would help ascertain the applicability of this transition technology between shifting and continuous cultivation.

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18. Based on the coefficients of variation (CV) and protected least significant differences (LSD) for treatment means, the experimental error estimate appears reasonable when using the above design; samples within treatments did not result in an error that is biased downward (L. A. Nelson, personal communication).
19. Although a significance test between fertilized and unfertilized crop yields for each harvest was not possible, the following model was fitted to the increasing differences (delta) between treatments over time with rice: $e^y = e^{b_1 \mathrm{time}} \cdot e^{b_2 \mathrm{time}^2}$, where y is delta yield (tons per hectare), time is months after burning, $b_1 = -2.465$, and $b_2 = 1.540$ are coefficients estimated from the data. An estimate of error of 0.091 (in log delta scale) was obtained by using this model (L. A. Nelson, personal communication).
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Mr. **Scheuer.** Dr. Sanchez, this is fascinating testimony and we ought to have a full day of hearing on the kind of agricultural research that we should be doing in the Western World to provide farmers with an opportunity to make a living in agriculture that would enable them to live in serenity with the tropical rain forests, and perhaps we'll talk to you about setting up a separate hearing.

Unfortunately, your very interesting testimony has consumed more time than we have this morning, but I want to thank you for that most interesting show and opening up a lot of doors that boggles the mind really.

We will be talking to you about coming back for another morning of hearings on agricultural research that ought to be done to enable the countries wherein these priceless tropical rain forests reside to show their farmers and their landless people how they can engage in agricultural pursuits that enable them to live in harmony with the tropical rain forests and don't force them to believe that they have to destroy the tropical rain forests in order to eke out a living in farming.

We thank you very much. We will now hear from Ronald Trostle.

Mr. **Shays.** Could I just ask a question?

Mr. **Scheuer.** Yes, by all means.

Mr. **Shays.** One of the messages that I'm getting that I really hadn't been forced to think about before is I think you're telling me that just as we settled our country and saw this vast frontier as being a wonderful benefit to us, the people of Brazil and other nations view that area the same way and probably feel as entitled to do what they want to their land as we did to ours.

Dr. **Sanchez.** That's very definitely the case, Mr. Shays. I think the point right now is that we are confronted and they are confronted, too, with our environment versus food production issues.

Mr. **Shays.** What that says to me is, and we obviously can't change that, I mean it's not our country, but what it says to me is that our best hope is to find ways that they can exploit that land without destroying it in the process.

Dr. **Sanchez.** Yes, sir, and the reason why we work in there in those countries. We work with them and these results can become part of their own programs. But that's exactly the point. I think with sustainable agricultural practices that are alternatives to slash and burn, we can reduce the demand tremendously for clearing additional forests.

Mr. **Shays.** Unless there is something that we in our country as an incentive to theirs, to Brazil or other countries, to give them something in exchange.

Dr. **Sanchez.** Well, right now what we are concerned about is the greenhouse effect, the global warming that the EPA says is due to this stuff. They don't care about that. The greenhouse effect is not going to affect the tropics very much. It's going to affect the temperate region, and it's kind of scary what may happen here in terms of shifting the center of gravity of food production north toward the Soviet Union and warming up some very good soils they have there. That could really affect us as a nation here seriously.

So I think we have a self-interest that we may want to make sure these things happen down there.

Mr. **Shays**. Could I just ask one more question

Mr. **Scheuer**. Chris, by all means, but we've only got 40 minutes left for the remaining two witnesses. So we are under terrific time pressure.

Mr. **Shays**. I guess we did too much talking and not enough listening here.

I just want to ask you one more thing. Are you saying in essence that the Soviet Union could potentially have a vested interest in not wanting to deal with the greenhouse effect?

Dr. **Sanchez**. What I can say, Mr. Congressman, is that looking at the soil potentials of Canada and the Soviet Union and assuming a three degree Centigrade increase in mean annual temperatures, there would be vast new areas of lands that are now too cold to grow crops that can grow crops in Canada and the Soviet Union of an unprecedented nature, and this could be very serious to us.

Mr. **Scheuer**. Thank you very, very much, Dr. Sanchez. I'm sorry we don't have much more time to spend with you, because you can see how intrigued all of us are.

We will now hear from Ronald Trostle, who has spent eight years working overseas for U.S.A.I.D. In 1980 he joined the Department of Agriculture's Economic Research Service.

We are happy to see you here, Mr. Trostle. We have 35 minutes left for you and Dr. Giddings, and we are sorry the time is closing in on us.

Please proceed and take your five or six minutes, and then we'll have some questions.

STATEMENT OF RONALD TROSTLE, CHIEF, COMMODITY AND TRADE ANALYSIS BRANCH U.S. DEPARTMENT OF AGRICULTURE

Mr. **Trostle**. Thank you, Mr. Chairman.

My assignment is to present a general outlook for future growth in world population and food production. My comments will summarize the paper submitted to the Subcommittee which asked three questions.

One is what are the prospects for population growth and the demand for food?

Two, has the growth in world food production started to slow down?

Three, are we on a path to a serious and sustained food/population imbalance?

The Subcommittee has heard and will hear from experts on population and production technology. So I am going to focus my comments on the dynamics between population and food production. But, first, I want to offer some background.

The world's population growth rate peaked at over two percent a year in the 1960's and has been declining since. The growth rate is currently about 1.7 percent a year, and is projected to drop to 1 percent a year by the year 2040. Even so, each year there are about 90 million additional people to feed and clothe.

World food production has grown more rapidly than population during the last four decades. Many people around the world eat more today than they did in 1950.

Mr. **Scheuer**. Is that true in the developing world?

Mr. **Trostle**. My initial comments are going to be about global food and global population. No, it's not true, but globally it is.

Food prices adjusted for inflation have trended down over the long term. During the last four decades real prices have fallen an average of two percent a year for cereals, as productivity gains more than offset rising food demand for food.

Mr. **Scheuer**. Again, does this mean that there is increased per capita food availability in the developing world at a cheaper price, food that they can afford for which there is effective demand?

Mr. **Trostle**. Not universally so, but globally that is true.

Mr. **Scheuer**. This is a case where global figures don't tell the story. I mean you can have a lake that has an average depth of six inches in which 12 kids drowned last year because there is one place that is 30 feet deep.

Mr. **Trostle**. That's right, Mr. Chairman, and I understand that. I'm going to deal with some of the distribution issues a little bit later. But my assignment that I was given was to deal with the global food production and population trends initially.

Mr. **Scheuer**. All right. Please proceed.

Mr. **Trostle**. It will only take a minute or two.

However, since the mid-1980's total world food production has shown little growth. A number of factors contributed to the slowdown in output.

In recent years large world stocks and low world prices of many agricultural commodities discouraged production.

The growth in global crop area has leveled off.

Mr. **Scheuer**. Now, excuse me. My colleague from Pennsylvania, Bob Walker, is not here, and I'm going to ask a question I'm sure he would ask.

Low agricultural prices have discouraged production. Is that the result of Chiefs of State in countries where they have a socialist economy setting food prices so low to please their urban populations that it doesn't provide an incentive for farmers to do anything but engage in subsistence farming?

Mr. **Trostle**. Mr. Chairman, what I'm trying to do is paint a picture of world global food production and consumption trends and talk about what is happening globally before I get into some of the details.

What I'm talking about is that, and I'll get to it later, is that the concerns about deficits in the 1970's gave rise to high prices and a change in policies which saw production go up in a lot of countries in the world. I'm talking about a world market system here that responds to prices, to shortages and surpluses.

I understand where you are coming from and I hope to get there.

Mr. **Scheuer**. Good. Please proceed.

Mr. **Trostle**. I was talking about the factors affecting slowdown in output since the 1980's. The growth in crop area has leveled off. This was particularly in response to lower farm prices. When you look at the statistics, the U.S. acreage setaside program has a major effect on world crop area.

However, there is a long-term constraint on land availability. Many countries have little opportunity to expand cropland, and most of the potential expansion is on marginal land. Land is being more intensively used in most of the world and this is causing some environmental problems which have been alluded to.

In the future, irrigation will play a reduced role in productivity growth and in the future also, I think we can see fertilizer and energy prices increase which will increase the cost of production for most producers in the world.

Technology will play a more important role in future gains in agricultural output because of the constraints on increasing planted area. However, there is some concern about the ability to sustain increases in productivity.

The growth in crop yields has recently shown minor signs of slowing down. The "green revolution" technologies have already been widely distributed. A gap between economically feasible yields in experiment stations, such as the International Rice Research Institute, and the actual yields on farmers' fields appear to be declining. This I think is a suggestion that the application of existing technology around the world is catching up with the development of new technologies.

Now it is true that there are many new technologies being discussed and developed. However, most of them involve a complex developmental process and there are considerable uncertainties about the outcomes. Also, many of the new technologies will not be globally applicable, particularly initially. Many of them will need additional regional adaptive research, which will take a considerable amount of time.

A critical issue is: Is the earth facing a food crisis, is the earth globally facing a food crisis? My analysts' analysis suggest that we are not. During the last four decades there were several short periods of relative shortage, even though the long-term trend in global per capita food production and consumption was upward.

When shortages did occur, prognosticators of the food crisis generally over-reacted to the short-run disequilibrium. The current concern about population/food imbalances must be analyzed in the context of the long-run evolution of a world food system.

World food output has risen about two and a half percent a year since 1960. Expansion in cropland contributed a half a percent a year to that growth, and productivity increases accounted for about 1.9 percent a year.

Now if productivity continues to climb at long-run trends, productivity increases alone, without any additional land, will exceed the lower population growth rates that are projected. Even if the growth rate of productivity gains slows to half the historic rate, half of the 1.9 percent a year rate, by the year say 2030 or 2040, world average per capita consumption could still be maintained.

Now, if world population growth rates do not decline as rapidly as they are projected by a number of demographers, or if world productivity growth slows down more quickly than expected, then world food production may begin to lag behind population growth and shortages may occur.

What happens if shortages do occur in the future either because of short-run weather problems or longer- term factors, such as environmental change? What happens is that prices will rise, leading to accelerated growth in food production and constrained consumption. We have seen it before.

To demonstrate the responsiveness of world agriculture to rising prices, one need only remember the food shortages of the 1970's and the ensuing price rises that led to the surpluses of the 1980's.

If production does not respond, for example, the technology isn't there, prices would continue to rise and diets would shift to more basic foods. The prices of meat, for example, would rise much more than the price of cereals and the basic foods, causing more grain to be consumed directly rather than fed to animals to produce meat.

The grain currently fed to livestock in the United States, Western Europe and Canada would feed nearly one billion additional people if consumed directly rather than as meat. Although the composition of food consumption would change—

Mr. **Scheuer**. And probably it would improve the health of those developed countries by vastly reducing cholesterol-induced heart and stroke and other illnesses.

Mr. **Trostle**. And it might also improve our own health.

Mr. **Scheuer**. As a matter of fact, in this country we have had a drastic change in diet in the last decade or decade and a half with an enormous reduction in the consumption of red meat, in the consumption of eggs and the consumption of cheese, and if you don't believe it, ask the meat industry, ask the poultry industry and ask the dairy industry. So that change may take place and there may be a lot less wheat and a lot less vegetable matter consumed by cattle which is destined for human consumption in the developed world, which would leave some of those grains and so forth available for human consumption.

Mr. **Trostle**. My point was that the composition of food consumption both in the developing countries and in the developing countries would change, but that there would still be adequate food supplies on a global basis.

Now let me get to your concerns, Mr. Chairman.

In the future increasing the food production will be a challenge. There is no doubt about that, but the major problems will be the distribution of population and food production. Some regions have surpluses and others have deficits.

Mr. **Scheuer**. Does that correspond to the developed world with surpluses and the developing world with shortages?

Mr. **Trostle**. It depends on how you define "developed" and "developing". It's not necessarily a one-to-one correlation. There are developing countries with food surpluses. There are low-income developing countries with food surpluses. Thailand is an example.

Mr. **Scheuer**. Thailand is not a typical developing country. It's an advanced developing country. I have been there on numerous occasions and you don't feel you're in a developing country, certainly not of the sub-Saharan Africa model when you're in Thailand. It's an educated, productive and rather sophisticated developing country that is making enormous strides. I mean they have a literacy rate of well over 90 percent, and they are getting into all kinds of industry at the cutting edge. So it's certainly not a typical developing country.

Mr. **Trostle**. That's right. It would be classified I guess as a lower-middle-income country.

Mr. **Scheuer**. I would think so, and on the way up fast.

Mr. **Trostle**. Food deficits in low-income countries have long been a problem, but the severity of problems in sub-Saharan Africa, Central America and some other countries have worsened significantly during the 1980's. Regional food production deficits are expected to grow larger, as we've heard already, in the future, and increased food aid will be necessary to help sustain current consumption levels in some regions. I'm saying they will not be able to do it alone.

Part of the challenge is for earth to produce enough food, but the more difficult issues concern the persistent inability of low-income, food-deficit countries to produce or import enough food.

Thank you.

[The prepared statement of Mr. Trostle follows:]

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Revised

Statement by Ronald G. Trostle, Chief
Commodity and Trade Analysis Branch
Commodity Economics Division
Economic Research Service
U.S. Department of Agriculture
before the
Subcommittee on Natural Resources,
Agricultural Research, and Environment
House Committee on Science, Space, and Technology
February 23, 1989

Thank you Mr. Chairman, I appreciate the opportunity to discuss world population and food production issues with the Subcommittee. My assignment is to present a general outlook for future growth in world population and food production.

We address the question of whether growth in global food production will be sufficient to support projected increases in population during the next 4 decades. Under reasonable assumptions, world food production will be adequate for the rest of this century. There is more uncertainty about the prospects for food production, distribution, and consumption as we enter the 21st century. World population is on a path to approach 10 billion persons around 2040. This population prospect, combined with food production growth possibilities, will bring significant changes to the world food system.

* World food production has grown more rapidly than population during the last 4 decades. Since 1950, trend growth in food production has been 2.4 percent a year, while population rose 1.9 percent a year. As a result, per capita food production climbed an average 0.5 percent a year. Many of earth's inhabitants eat more now than they did in 1950.

* There has been a long-term downward trend in food prices, adjusted for inflation, as increases in productivity more than offset larger demand for food. During the past 4 decades, cereals prices, adjusted for inflation, fell an average of 2 percent a year.

* The world population growth rate has been slowing during the last 2 decades and is projected to continue to decline significantly during the next 4 decades.

* On balance, food production should be sufficient to maintain world average per capita consumption for the rest of this century. During the first quarter of the 21st century, sustaining growth in food production could become difficult, particularly if climatic change occurs or environmental problems become more widespread. However, the real challenge will be the distribution of food from surplus to deficit regions.

The growth in the earth's population during the 20th century has been unprecedented. Only a series of equally unprecedented technological breakthroughs enabled food production to more than keep up. Significant new technical advances will be required to maintain per capita consumption into the 21st century.

Short-term local and regional food shortages (and surpluses) have occurred many times in history. Divergences from long-run trends leading to food shortages invariably caused prices to rise and production and consumption to adjust.

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During recent periods of surplus and shortage, prognosticators of the future have often over reacted to the short-run disequilibrium. The current situation must be analyzed and understood in the context of the long-term evolution of the world food production, distribution, and consumption system.

My comments address 3 issues:

- What are the prospects for population growth and the demand for food?
- Has the growth in world food production started a long-term slowdown?
- Are we on a path to a serious and sustained food-population imbalance? If so, what kind of an imbalance, and what will be the impact?

Prospects for World Population and Food Demand

World population has reached about 5.2 billion persons (table 1). The population growth rate peaked at 2.1 percent a year in the 1960's and has declined to 1.7 percent in recent years. Even so, it means there are 90 million more people to feed and clothe each year, and the annual increase grows larger each year.

The U.S. Bureau of the Census projects that world population will climb 20 percent to 6.2 billion by the year 2000, and will reach 10 billion by about 2040 (1). The growth rate is projected to slow to less than 1.6 percent by the year 2000, and to drop to about 1 percent by 2030 (figure 1).

Population growth rates vary widely for different countries. West Germany's population has been declining since the mid-1970's and many other European countries have stable populations. High rates of population growth (above 2

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percent a year) continue in Sub-Saharan and North Africa, Central and South America, the Mid-East, and South and Southeast Asia. The disparity of population growth rates is projected to continue as illustrated by figure 2.

An increasing population presents a nutritionally based need for additional food. However, the ability of citizens of low income countries to produce or buy food is already limited. In the future, their effective demand for food will be influenced by economic development and the growth and distribution of income. Medium term prospects (to the year 2000) suggest that economic growth will continue, and that most countries will be able to afford higher per capita consumption. However, there is a group of low income nations which will continue to have very limited income and financial resources to allocate to food.

In the longer run, population growth and world economic growth will increase global demand for food. The desire to improve diets will boost the demand for meat and for the feedstuffs to produce animal products. But, demand gains will not be equally distributed. Effective demand in high and most middle income countries will support increased food consumption, at least into the early 2000's. In contrast, per capita consumption is declining even now in some countries in Sub-Saharan Africa, Central America, and South Asia.

Prospects For World Food Production

World agricultural production has trended upward at 2.4 percent year since 1950. Per capita food production rose 0.5 percent a year and much of the world's population is eating more than in the 1950's (figure 3). The 1980's has generally been a decade of excess food production capacity and large

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surpluses of many agricultural commodities. However, measures of total world production have shown little growth since the mid-1980's. A number of factors are associated with the slowdown in production, including lower prices, poor weather and use of land. There is not yet sufficient evidence to indicate that the stagnation represents a permanent shift to a slower growth trend.

Food prices have trended downward, in inflation-adjusted terms, for the last 4 decades (figure 4) as production has continued to increase because of rising productivity. When shortages have occurred in the past, prices have risen, and production increased. When we are faced with food shortages in the future -- caused by either short-term weather problems or longer-term factors -- prices will rise and accelerate growth in food production and constrain growth in consumption. The perceived food shortages and ensuing price rises and changes in governmental policies of the 1970's leading to the surpluses of the 1980's demonstrate the responsiveness of world agriculture to changes in commodity prices.

During the 1980's period of surpluses, exporters competed fiercely for world markets. As a result, world prices dropped sharply, reaching historic lows when adjusted for inflation (figure 4). Average cereals prices between 1985 and 1987, measured in 1982 constant dollars, were 40-50 percent below levels of the early 1960's. Soybean prices declined 35-40 percent. Wheat prices have trended downward at about 2 percent a year since 1960. Other cereals and oilseeds followed similar trends.

In recent years, low world prices leading to weaker production incentives for many commodities contributed to slower growth in production. Poor weather and production in India, Eastern Europe, and Latin America, and U.S. acreage

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reduction programs, were other short-run factors. Future constraints which may have a longer-term affect on slowing growth in food production include limitations on increasing cropland and on production practices which cause environmental problems, slower technological advances, and higher energy prices.

The Land Constraint

Population growth has risen more rapidly than the expansion in world cropland. The population growth rate declined from 2 percent per year in the 1950's to the current 1.7 percent. During the same period, the rate of cropland expansion fell from 1 to less than 0.3 percent (2). This resulted in a significant global drop in per capita cropland availability.

The area planted to field crops (grains, oilseeds, roots, pulses, sugar, cotton, and tobacco) outside the United States expanded about 0.8 percent a year during the 1960's (figure 5). During the last 10 years, expansion has leveled off. Total world cropland set a record in 1987, but it was only slightly above the previous 1978 record. Land in permanent pastures expanded slowly through the mid-1970's and then began to decline (2). Forests and woodlands declined steadily over the course of the 3 decades. Since the mid-1970's, the reclamation of desert land for agricultural uses has not offset the amount of cropland, pasture, and forests that were lost to urban, commercial, and recreational uses.

Many countries have little potential to expand cropland because of already dense population, poor climates, or poor quality of land. Because of terrain, climate, and population density, Latin America, and particularly the countries

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of Argentina, Brazil, Uruguay, and to a lesser extent Chile, has the greatest potential for cropland expansion. A large area of potential agricultural land also exists in the Sudan. Only the United States has significant excess productive capacity already in existence.

Most of the land that is being added to the world's cropland base is marginally productive. Also, land is being used more intensively in most of the world. In a number of developing countries, practices such as multiple cropping and increasing intensity of slash and burn are mining soil fertility and causing erosion and subsequent siltation of downstream irrigation, flood control, and hydroelectric facilities. In some locations, the deforestation, erosion, and desertification that are resulting from intense competition for food and fuel are causing permanent loss ot productive capacity. These problems are more serious in low income countries with high population-to-cropland ratios.

Irrigation will play a reduced role in increasing productivity in the future. Cropland under irrigation is not expanding as rapidly as previously. Most of the remaining feasible irrigation projects that have been identified will require costly investments. Some of the investment going into irrigation is for the rehabilitation of existing infrastructure in the developing countries. Tube well irrigation has mined water from underground aquifers and lowered water tables in several parts of the world, and raised the cost of pumping irrigation water.

The cereals sector illustrates the trends and developments in production that are affecting most agricultural products. Between 1960 and 1987, the growth in foreign production of total cereals averaged 2.7 percent a year. The 2.3-

percent growth rate of average yields contributed more to increasing output than did the average 0.4-percent annual expansion in area (figure 6). World cereals area peaked in 1981. Thereafter, growing surpluses led to declining prices, and to reduced acreage devoted to cereals in the United States and many other countries.

Role of Technology

It is unlikely that increases in land area will make significant additional contributions to production in the future unless food prices increase substantially. Gains in agricultural output will depend more on technological advances because of the constraints on increasing planted area.

The "green revolution" rice and wheat technologies have now been widely distributed. Indeed, appropriate application rates for fertilizer and pesticides have been exceeded in some areas. The growth in crop yields has recently shown minor signs of slowing down although this may have been a response to lower world producer prices rather than a lack of technical innovations. But there will be concern about the future until there is more certainty about the new technology on the horizon. Doubts persist about whether new technology will have the same impact on output as did hybrid corn, fertilizers, and the high yielding varieties of rice and wheat.

Fertilizer will continue to play a major role in future productivity. Reserves of phosphates and potash appear to be sufficient to cover needs for many years. Nitrogen production capacity will require expansion by the latter part of the 1990's.

There is potential for real energy prices to rise sometime during the next several decades. Higher energy prices increase farm power and fertilizer costs, and hence the cost of food production. International freight rates to transport grain between surplus and deficit areas would also rise. There may be incentives to shift some crop land to biomass fuel production.

Potential Productivity Enhancements

Yield enhancing technologies continue to be developed. However, technological advance requires considerable, sustained financial investment over long time periods. During a food shortage and high farm prices, existing technology and previously uneconomic technology are quickly exploited. But, the rate of development of new technology generated by basic research does not adjust quickly.

Some of the more likely developments in the 21st century, from among technologies now being discussed by scientists include:

- Crop varieties with improved drought and disease resistance will help stem the trend to greater yield variability in coarse grains and rice. (The variability in wheat yields has declined somewhat during the last 3 decades.)
- Varieties with shorter growing seasons will reduce risk of early fall frosts in regions where currently planted and expand the geographical range where the crop can be produced.
- Crops with the ability to fix atmospheric nitrogen in the soil would reduce reliance on petroleum based fertilizers.

- New methods of plant protection will reduce toxic residues.
- Animal growth promotants that increase the efficiency of feed and lower production costs will become more widely used.

New production processes are expected to enhance productivity and reduce harmful environmental side effects. An example would be expanded use of irrigation processes which would make more efficient use of available water and reduce loss of nutrients and ground water contamination due to leaching. The use of hydroponic production processes to recycle water and residual nutrients is another possibility.

Improved farm management and production practices have the potential to increase food production efficiency in many parts of the world. This can only be accomplished through the long process of educating producers and modifying policies to encourage proper farming systems.

Environmental Concerns Will Play a Larger Role

Some technological advances have had undesirable environmental side effects. Increased reliance on petroleum energy, ground water contamination caused by fertilizer and pesticides, lower water tables resulting from deep well irrigation, and erosion caused by intensive use of land and by farming marginal land have each contributed to environmental problems. Industrial practices which contribute to acid rain and deforestation also affect agriculture. Future technological advances will have to focus on sources of productivity that minimize negative effects on environmental quality.

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What About Climatic Change (global warming)?

The impact of a greenhouse effect is difficult to evaluate at this time because the experts have not yet given us a global warming scenario with regional details about changes in temperature, precipitation, and seasonality, or the effects of higher CO_2 on food production.

Is Earth Facing a Food-Population Crises?

The Global Perspective

World food output rose 2.4 percent a year during the last 3 decades. Expansion in crop land contributed 0.5 percent a year to the growth and productivity increases accounted for about 1.9 percent a year (figure 7). Since the rate growth of population was less than of food output, average per capita consumption rose. In the future, additions to crop land will likely be negligible so increasing food output will depend on raising productivity. If productivity continues to climb at long-term trend rates, productivity increases alone -- without any additional land -- will exceed the lower population growth rates that are projected. Even if productivity growth slowly declined from the historical 1.9 percent to 1 percent by the year 2040, world average per capita consumption could still be maintained.

Food production and population have alternative longer run scenarios. If long-run productivity growth does not continue, or if world population growth rates do not decline as rapidly as projected, world food production could begin to lag behind population growth. If that scenario occurs, food prices will rise and diets will shift toward staples. Because the prices of non-staple foods -- meat for example -- will rise more than staples, more grain

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will be consumed directly, rather than fed to animals to produce meat. The grain currently fed to livestock in the United States, Western Europe, and Canada would feed nearly 1 billion additional people annually if consumed directly rather than as meat. If food prices were to rise considerably, livestock production would decline significantly. Marginal land in pasture would still produce considerable quantities of ruminant livestock products. Although the composition of food consumption would change, there could still be adequate food supplies, on a global basis.

Distribution Issues

Global growth in population and food production is not the main challenge facing earth's society -- unless climatic change or environmental concerns become a larger than anticipated problem. The major problem will be the distribution of population and production growth. Some countries/regions have food surpluses; others have growing deficits. Distributional aspects of effective demand, revolving around the inability to finance imports and need for food aid, will remain major problems and may even increase relative to production possibilities.

The problems of getting food from those who produce it to those who need it will likely become more severe in the future. Domestic and international markets have become more interdependent as transportation and handling costs declined. In some countries, policies have tended to move from encouraging self-sufficiency to exploiting comparative agricultural and nonagricultural advantages. One result is that international trade in food products has grown more rapidly than production and consumption. A second result is that some countries/regions operate with large food production deficits. This is not a

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problem for middle income industrial countries with adequate export earnings. Indeed, Taiwan and Korea have singificantly improved their ability to meet food needs. However, for low income countries with low export earnings, considerable foreign debt, and high population densities and population growth rates, food deficits are a burden for the country and on the community of foreign donors.

Food deficits in low income countries have long been a problem, but the severity of problems in Sub-Saharan Africa (figure 8), Central America, and some other countries have worsened during the 1980's. The food production deficits are expected to grow significantly larger in the future. Food aid donors' surpluses and a willingness to finance food aid expenditures will be necessary to sustain current consumption levels in some regions. The 21st century alternative to food aid for these countries is widespread malnutrition, or even starvation.

In the 1960's, the developing countries had a $15 billion agricultural trade surplus. During the last 15 years, that trade surplus has disappeared (figure 9). The trade surplus fell rapidly in the late 1970's and early 1980's as rising per capita income and the availability of international credit boosted demand. Low income country food deficits can lead to social unrest and political tensions. Internally, declining per capita consumption would cause social and political unrest. Internationally, donor countries may be reluctant to bear the cost of rising needs for food aid.

Part of the challenge is for earth to produce enough food. But the more difficult issues concern the persistent inability of low income, food deficit regions to either produce or import enough food.

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Summary

On balance, global growth in food production should be able to keep pace with global population and income growth, at least well into the 21st century. After that, it is less certain. Globally, average per capita consumption may begin to decline slowly unless new environmentally acceptable technologies are developed. Widespread global malnutrition is not likely -- unless climatic change or natural resource degradation cause significant production problems. Shortages will undoubtedly occur because of short-run weather or policy aberrations and may persist due to longer-term problems. Domestic and international market responses will include changes in the composition of food production and of diets. The major challenges facing world leaders will concern the increasing food deficits in some low income regions of the world, and the environmental impacts of increasingly intensive agricultural production.

Thank you very much Mr. Chairman, that concludes my testimony. I will be happy to respond to any questions you or the other members of the Subcommittee may have.

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FIGURES

1 World population growth rates, history and projections, 1950-2040

2 Population growth rates: selected regions, history and projections, 1950-2040

3 World agricultural production indices, total and per capita, 1950-1987

4 Wheat price, 1982 constant dollars, 1945-88

5 Foreign crop area, 1960-88

6 Foreign cereals: area, yield and production, 1960-88

7 World agricultural production: contributions of area and productivity, 1960-87

8 Sub-Saharan Wheat: production, consumption and imports, 1960-88

9 Real agricultural net exports in developing countries, 1960-86

Title 1 -- Historical and projected population, 1950-2040: world, United States, and selected regions

Year	World	U.S.	Foreign	Central America	South America	Western Europe	Eastern Europe	USSR	North Africa	Sub-Saharan	Mid-East	South Asia	Southeast Asia	East Asia
							Millions							
1950	2,565	152	2,413	38	111	286	106	180	45	193	59	472	183	688
1955	2,790	166	2,624	44	128	296	112	196	50	213	68	518	203	740
1960	3,050	181	2,869	51	146	309	117	214	57	237	78	572	229	795
1965	3,359	194	3,165	60	168	323	121	231	64	268	90	637	260	873
1970	3,721	205	3,516	70	191	335	126	243	72	304	103	714	291	991
1975	4,104	216	3,888	81	216	344	130	255	81	347	119	800	327	1,103
1980	4,477	228	4,239	93	242	350	134	266	93	400	139	894	365	1,181
1985	4,882	239	4,642	104	272	354	138	279	107	462	163	1,003	409	1,255
1990	5,320	250	5,069	116	304	359	141	291	123	537	189	1,117	455	1,334
1995	5,774	260	5,514	129	337	362	143	301	139	627	218	1,233	503	1,409
2000	6,241	268	5,973	141	370	365	145	312	157	730	250	1,349	551	1,481
2005	6,709	275	6,434	154	403	365	147	322	174	847	285	1,466	599	1,540
2010	7,192	282	6,910	167	437	364	149	334	192	977	323	1,584	647	1,597
2015	7,687	288	7,399	179	471	362	150	345	211	1,121	365	1,701	695	1,652
2020	8,185	294	7,891	190	504	359	151	355	228	1,276	410	1,816	743	1,702
2025	8,675	298	8,377	201	536	355	151	364	246	1,441	458	1,927	790	1,746
2030	9,145	300	8,845	211	566	350	151	371	263	1,613	508	2,032	834	1,777
2035	9,594	301	9,293	220	595	343	150	377	279	1,790	560	2,129	876	1,797
2040	10,021	301	9,720	228	621	335	149	381	294	1,972	613	2,219	915	1,810
2045	10,426	301	10,126	235	644	326	148	384	308	2,155	668	2,301	950	1,818
2050	10,805	299	10,506	241	666	316	146	386	321	2,339	723	2,374	982	1,817

Source of statistics: U.S. Bureau of the Census

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Figure 1

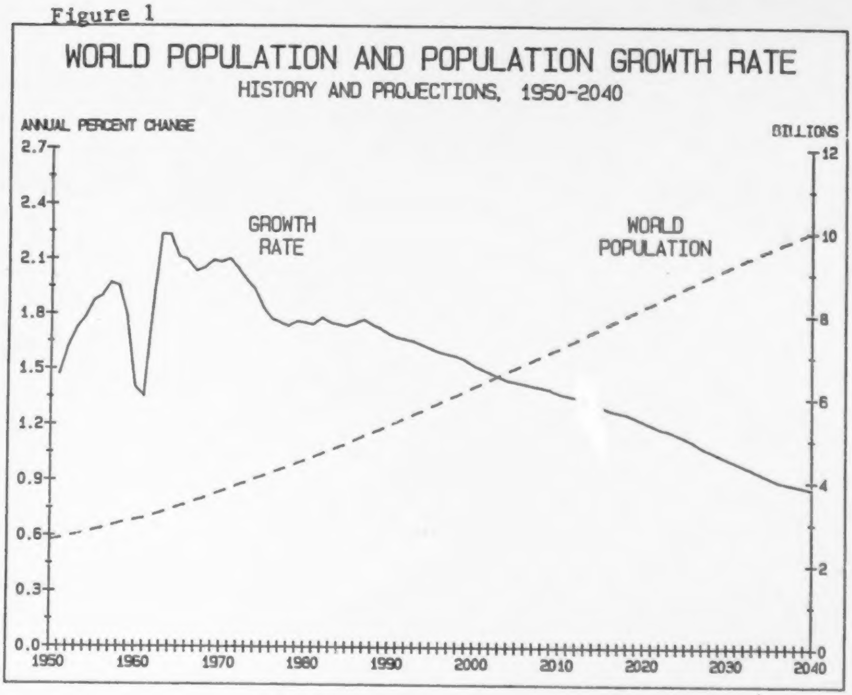


Figure 2

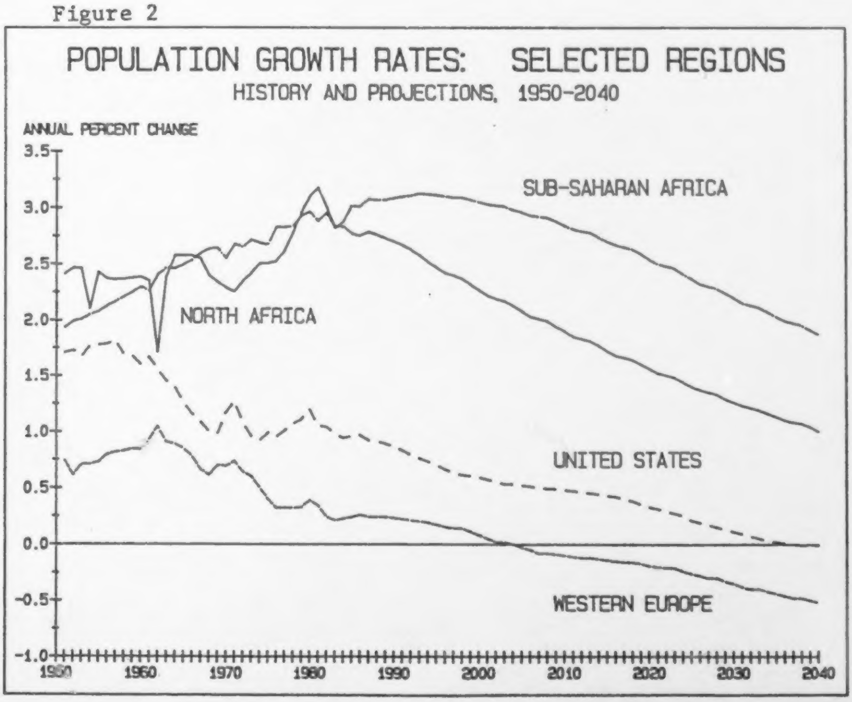


Figure 3

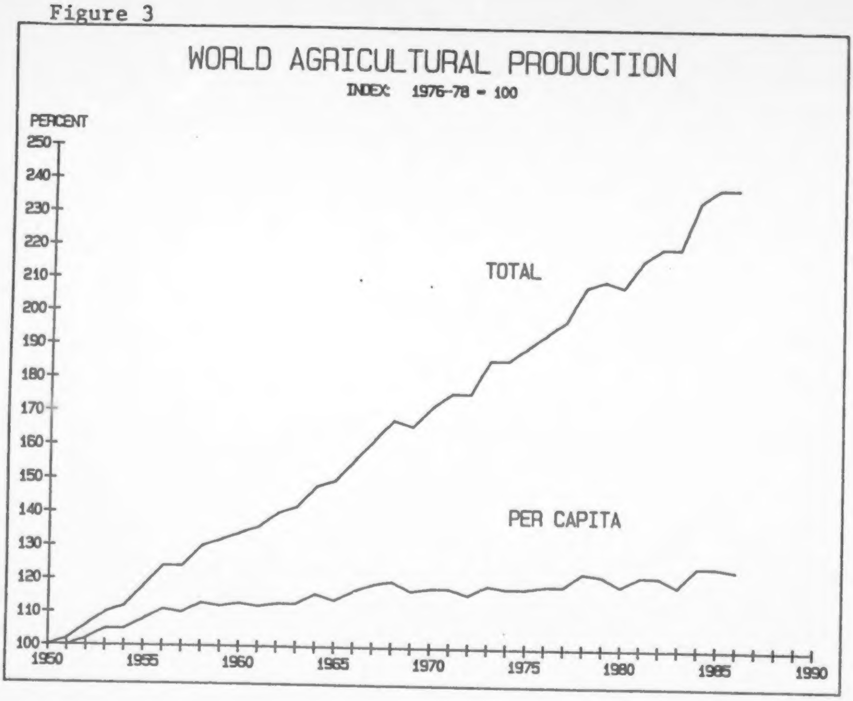


Figure 4

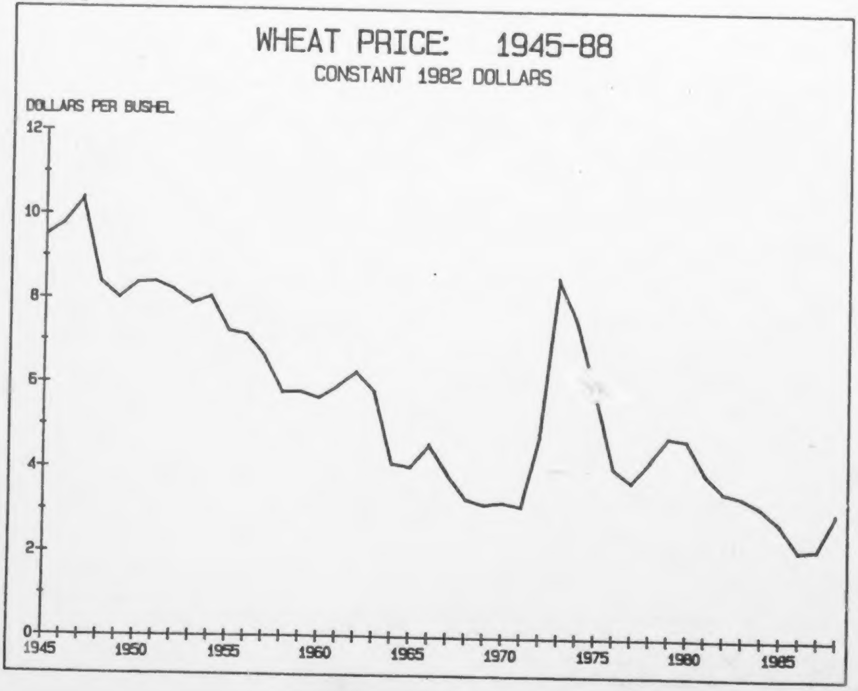


Figure 5

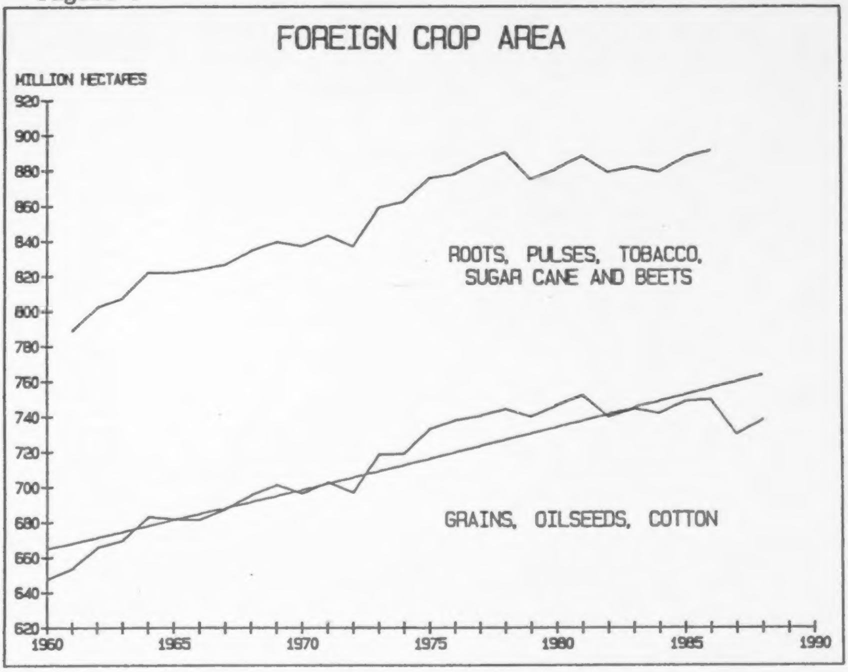


Figure 6

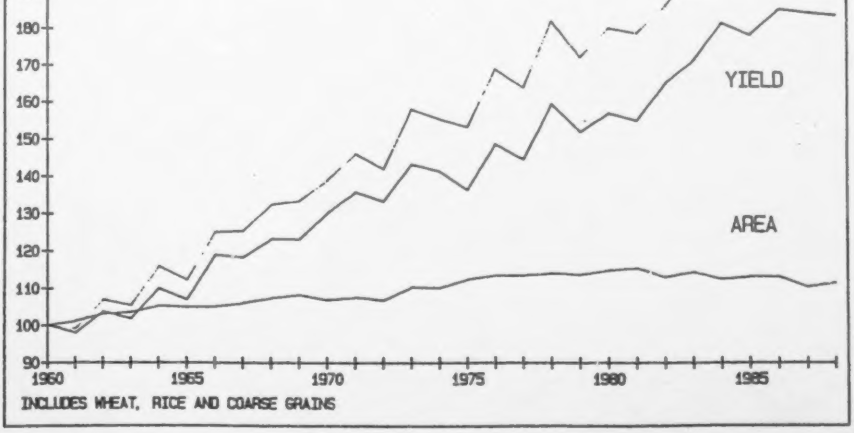


Figure 7

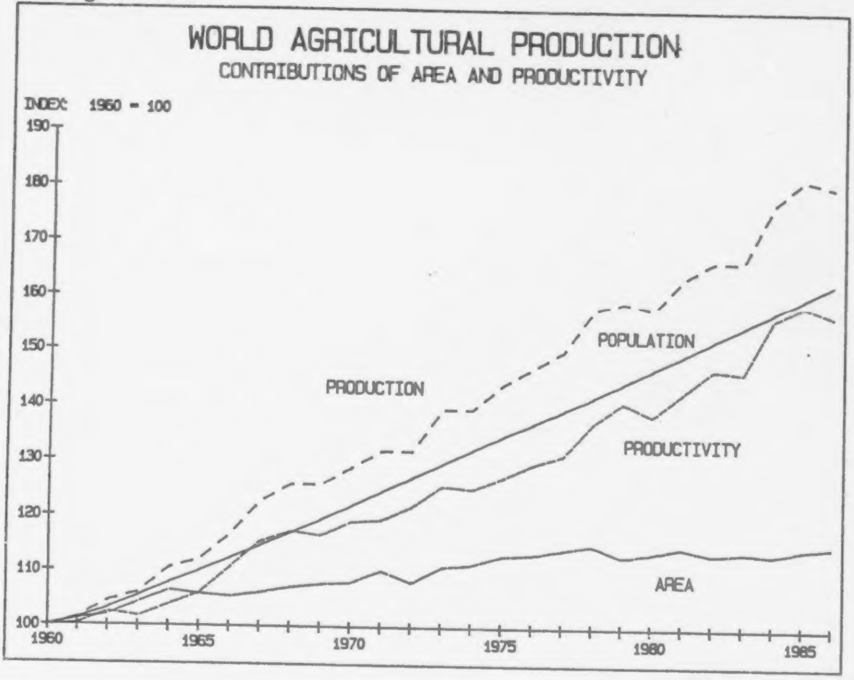


Figure 8

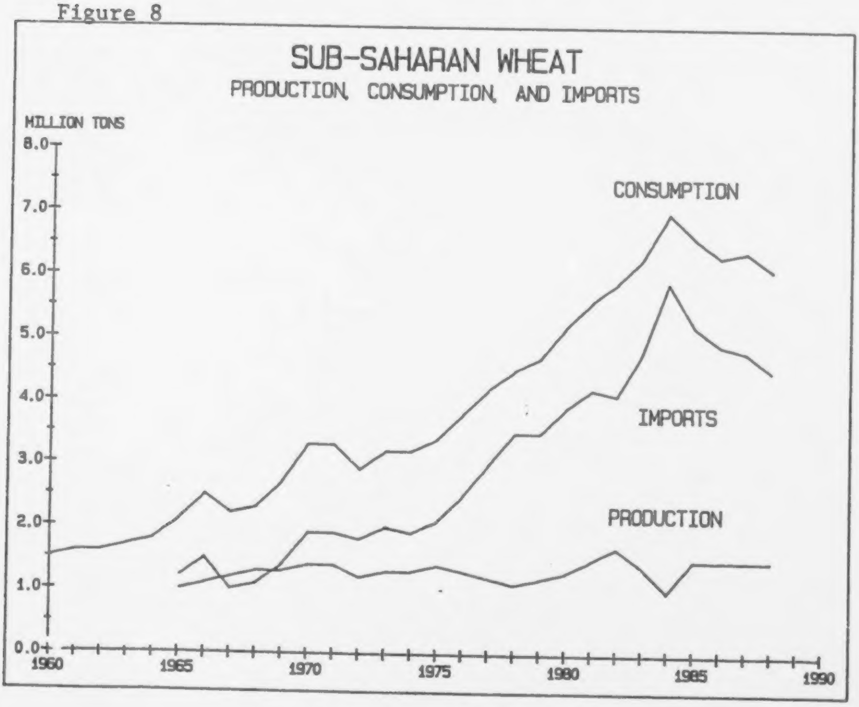
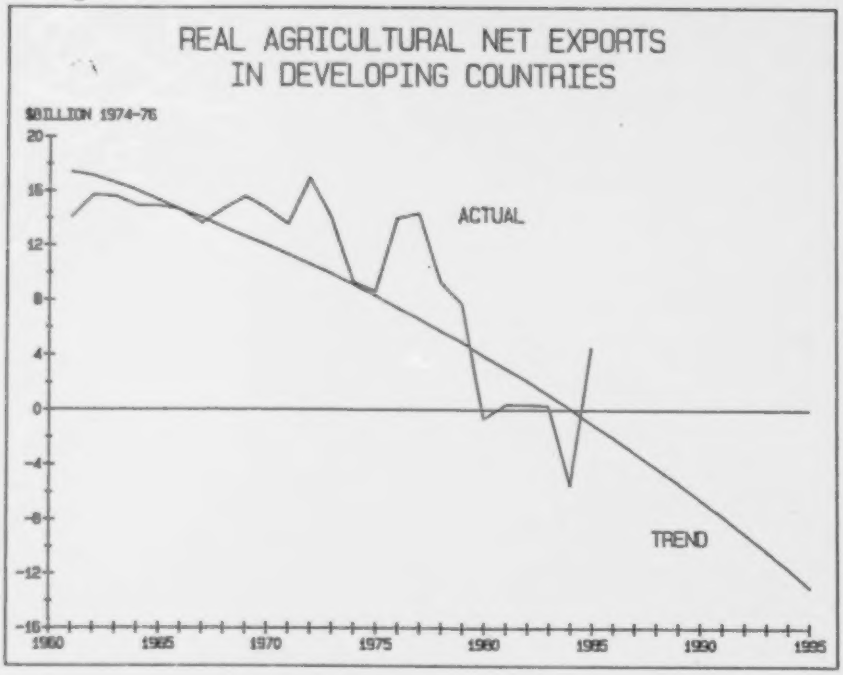


Figure 9



REAL AGRICULTURAL NET EXPORTS IN DEVELOPING COUNTRIES

Mr. SCHEUER. Congressman Shays.

Mr. SHAYS. No questions.

Mr. SCHEUER. Well, you've raised a whole host of questions, but we only have 20 minutes left for the next witness. So I'm going to direct some questions to you by mail.

Just on that last comment of yours, is some of their inability to raise enough food in the food deficit areas of the developing world caused by the kind of food pricing policies of their governments that Congressman Walker and I discussed a little while ago?

Mr. TROSTLE. Yes, there is no doubt about it. There has been through history just innumerable cases of where policies changed food prices and food production responded.

Mr. SCHEUER. Ought it be a goal of our food aid program to encourage as much domestic consumption of food as is possible by encouraging those governments either to liberate food and let food prices be controlled by the market or at least to increase the controlled price to the point where it provides an incentive for farmers to produce food?

Mr. TROSTLE. I think that in a number of countries they will be forced to do so when they have limited foreign exchange to import food, and over the next 5 to 10 years let's say that some of the donor countries become more reluctant with their own budget deficits to finance food aid. They may be forced to let the market send incentives to producers so that they produce more of their own food domestically.

Mr. SCHEUER. Would any other members of the panel care to respond to that question, Dr. Chandler or anybody?

Dr. CHANDLER. I don't think there is any question, Mr. Chairman, but what food aid is a disincentive to local production. I don't think there is any question about it.

Mr. SCHEUER. You're joining Dr. Norman Borlaug?

Dr. CHANDLER. Yes. Norm and I have worked together for a long time.

Mr. SCHEUER. Well, he's a Nobel Prize Winner and you're a World Food Prize Winner. So I think we ought to take the two of you very seriously.

Dr. CHANDLER. But, on the other hand, you can't deal with these things immediately sometimes. Just to go back to Bangladesh, if you would just cut off food aid and bring in two million metric tons a year, you cut that off tomorrow and you're going to have a lot of people starving. I just think that you've got to help them the best you can in the fastest way possible to do it with our help to increase their production.

Mr. SCHEUER. We're not talking about cutting off food aid. We are talking about some kind of a program of conditionality perhaps, elbow twisting, jawboning that would suggest to them that if they want this flow of aid from us to continue, they ought to exert some best efforts, and part of their best efforts would be to price food at a level which provides an incentive for their own farmers domestically to produce food for sale in their own countries and not just to engage in subsistence farming.

Now isn't that something that would be perfectly moral for us to do?

Dr. **Chandler**. Yes, I think so, except that I'm not an economist. I was just in Bangladesh with a whole group of economists and they were arguing whether or not they should support food prices at a level that is profitable to the farmer or whether they should subsidize the inputs and keep the prices fairly low for the urban consumer because the urban consumer didn't have money enough to buy food at higher prices. It's a real problem, and I don't know the full answer to that. It depends on the country you're in, I think.

But I do think as a general principle, as I said before, that importing food is something which is a disincentive to food production. We should concentrate all the effort we can to get the research done in the country to show how they can produce more and to encourage countries to have policies to get that to farmers and have it in operation.

Mr. **Scheuer**. To encourage food pricing policies.

Dr. **Chandler**. That's part of it, yes, but you've also got the technology. I would disagree with the gentleman on my left that all of this increase in food production in Asia in the 1970's was due to price. It was also due to the fact that you had a technology that would work and increase yields which did depress prices.

Mr. **Scheuer**. I don't think Mr. Trostle would want to deny credit to you for the magnificent work you've done in the Philippines in providing new technology. I think he is just saying, having given you full credit, enormous credit, that price also has a way of being an important factor in providing incentives for farmers to use the marvelous new technologies you've developed to put food into the market apparatus and getting it into the stream of commerce.

Is that more or less a fair paraphrase of what you had said?

Mr. **Trostle**. That's very well said.

Mr. **Scheuer**. I don't want to put words in your mouth, Mr. Trostle.

[Laughter.]

Congressman Shays, aren't you stimulated?

Mr. **Shays**. I am stimulated, but also I'm aware of the time.

[Laughter.]

Mr. **Scheuer**. Okay. We're under terrible time constraints. It has only been because you have all been so stimulating and productive.

Dr. Sanchez, I noticed you seemed to want to say something about this whole question of food pricing by socialist market Chiefs of State as providing a disincentive, if I can use that awful economist word, to local farmers in raising food.

Dr. **Sanchez**. I'll give you one specific example, Mr. Chairman. I traveled to northern Zambia last year. What I saw in northern Zambia was a piece of land which was identical to the central plateau of Brazil where major increases of food production has taken place in the last 10 years. It's just the same thing over there.

I went to a marketplace and I bought a bunch of bananas and I paid less than a U.S. cent per banana, and I said there is no way anything can happen in this country in increasing food production until those prices go up, even though you may have the land resources, the transferability and technology and so on.

So I very much agree with you on your point of prices. It's a necessary, but not sufficient condition, and again policy and technology have to go hand in hand.

Mr. Scheuer. That's what Mr. Trostle said, that's what Dr. Chandler said and that's what Norman Borlaug says. So I guess we're all in agreement.

All right. I hate to leave you wonderful witnesses, but we've got to move on. We have exactly 15 minutes for the last witness. I suppose we'll go five minutes late.

Dr. Giddings is a biotechnology consultant for the Biotechnology Study Project at the World Bank, and before he joined the World Bank he was a Study Director with the Biological Application Program of the Congressional Office of Technology Assessment, the famous OTA.

We are delighted to have you here, Dr. Giddings. We have 20 minutes to cope with your testimony, and I know we are going to be frustrated because you're going to raise an awful lot of interesting and thoughtful questions for us to think about, but please proceed for five or six minutes and then we'll have some time for discussion.

STATEMENT OF DR. LUTHER VAL GIDDINGS, BIOTECHNOLOGY CONSULTANT, THE WORLD BANK

Dr. Giddings. Thank you, Congressman. I am delighted to be here.

We may actually have enough time. I will be very brief in condensing my written comments, which will be entered into the record.

What I would like to do today is make a few comments about the potential that biotechnology holds for contributing to both sides of the problem that you're here discussing this morning, the production of food and the management of human fertility.

No person familiar with these issues, familiar with the tools of biotechnology or agricultural science doubts that there are substantial advances to be made in applying the tools of biotechnology to agricultural science.

Let me give you two very brief examples of the kinds of things that are now technically feasible that are going to lead to increases in food production.

The first is epitomized by the work of Dr. Roger Beachy at Washington University in St. Louis collaborating with the research teams from Monsanto. Dr. Beachy and colleagues have developed something called viral cross-protection in plants. There are a whole host of viral diseases that affect different crop plants and cause losses in yield or productivity.

There has been a phenomenon long known, although not completely understood, by which infection with a strain of virus that does not produce serious yield reducing penalties can protect a crop plant from infection with a related form of the virus which causes dramatic losses in yields. This is called cross-protection.

What Dr. Beachy and his group have succeeded in doing is cloning a gene that produces a protein, the coat protein for the virus, an important constituent in what the virus uses for a cell membrane analogue. They have inserted this gene into the genetic material of plant species themselves, a very small piece of the viral genetic material, which does not in fact cause the disease symptoms that reduce yield.

So what you've got then is a chimeric plant, a crop plant which contains a piece of viral DNA, and in so containing it somehow triggers this viral cross- protection phenomenon that protects the genetically engineered host plant from infection with the more virulent forms of the virus that cause losses in yield.

Since in some countries, particularly in some tropical countries, annual losses or yield reductions to viral diseases amount to as much as 50 percent, the potential for improving yields is quite clear and dramatic.

Mr. SCHEUER. Well, I suppose in net result that would be comparable to the green revolution that Dr. Chandler helped to produce. He produced the seed that provided enormous additional increases in productivity, and you're providing a gene input that enables a very much larger percentage of that increased productivity to survive to maturity.

Dr. GIDDINGS. Exactly.

Mr. SCHEUER. You're partners here really.

Dr. GIDDINGS. Well, collaboration between different research groups is one of the very important ways in which this kind of progress will be brought about.

Mr. SCHEUER. Absolutely.

Dr. GIDDINGS. I might point out something I did not develop extensively in my written testimony, although this is an area that we are exploring at the Bank. The next example of potential progress that I want to give you will be more productive when it is linked with the kinds of programs that we've heard about earlier, especially those pioneered in the Philippines with classical selection schemes for producing new high- yielding varieties.

This next tool that I would like to mention to you, this next tool of biotechnology—

Mr. SCHEUER. Let me just interrupt you one second.

Dr. GIDDINGS. Sure.

Mr. SCHEUER. During the early 70's and mid-70's when this agricultural revolution began to take form under Dr. Chandler's guidance and some others in the Philippines, of course we didn't have a science of biotechnology and genetic engineering and intervention of that kind. That was unknown in those days, right?

Dr. GIDDINGS. Well, it was known by another name, perhaps.

Mr. SCHEUER. Did the green revolution encompass what we now think of as genetic engineering?

Dr. GIDDINGS. No.

Mr. SCHEUER. Is there a possibility of sort of giving sort of a supercharging effect to the green revolution now by taking all these marvelous new plants and seeds that you develop and engineering them genetically so that they are very much more insect resistant, blight resistant, drought resistant, heat resistant, cold resistant than they are naturally?

Mr. TROSTLE. Yes, sir.

Dr. CHANDLER. I mentioned that in my testimony. I think that is a real possibility. One of the biggest impacts biotechnology and genetic engineering, or whatever you want to call it in the future, is going to be a stabilization of yields at high levels because you are cutting out the impact of insect and disease attack, adverse soil conditions, et cetera.

Mr. **Scheuer.** So that's really giving your green revolution another shot in the arm.

Dr. **Chandler.** Right, that's another shot in the arm, although I doubt that it will double yields.

Mr. **Scheuer.** Thank you.

Dr. Giddings, please proceed.

Dr. **Giddings.** If I should fail in the summary of my remarks to mention some of the constraints, some of the technological constraints on application of this technology, please bring me back to the question because although there is enormous potential here in the application of the tools of biotechnology to agricultural production, there are also some very real constraints.

In addition to the political constraints and economic constraints you have already heard about, there are some scientific constraints that will in fact limit what this new technology can provide.

Another example of the way in which this new technology will lead to potentially dramatic increases in production, and this is one I find particularly very exciting because in contrast to the engineered viral cross-protection in plants that I mentioned from Washington University and Monsanto, this technique, this technology is broadly applicable to all sorts of plants and animals and indeed microbes and virtually every organism you can cultivate or raise in captivity can be improved through this technology.

The jargon for this technology is RFLP mapping, restriction fragment length polymorphism mapping. What this means in intelligible language is that—and let me back up and give you a little bit of background.

The kind of work that was so successful in the Philippines and at CIMMYT and other research organizations around the world that have been devoted to producing new improved high-yield crop varieties, they have used what I refer to as the classical methods of selection, breeding programs designed to use existing genetic variations within the crop varieties themselves to breed the traits into the lines that you want and thus produce the desired effect as the end result of your breeding program.

These operations are very difficult and complicated to carry out because many of the genetic traits involved are controlled not simply by one gene. They are not Mendelian traits as we call them, but they are in fact very often influenced by a series of genes operating in concert together. They are called multi-genic or poly- genic traits.

It is extremely difficult to use a classical selection scheme to transfer such groups of genes from one strain into another so that you can combine productivity with insect resistance and herbicide resistance or saline tolerance and things like that. It is difficult to work with a whole bunch of genes at once because it's very difficult to analyze the results of your genetic screening and breeding programs.

What this RFLP mapping technique does is, it lets you work with small amounts of plant tissue at an embryonic or juvenile stage to identify the location of these genes on the chromosomes that are in the populations of interest to you. In fact, it gives you a short-cut way of conducting a breeding program. You don't have to wait for the crop to come to maturity and express the trait you're interested in and then work through subsequent generations to transfer it over a long and complicated process.

What you can do is identify at a very early stage where the genes are on these chromosomes and you can select amongst a whole variety of offspring from a given crop, you can select and identify at a very early stage those individual plants which contain the combinations of genetic characters that you want, and you can select them and concentrate your focus on them and you can dramatically improve the time it takes to yield new varieties. In some cases you can cut it by as much as a half or possibly even more than that.

So instead of taking 10 or 15 years to produce a new variety, you might be able to do it in 5 or 10 years and work simultaneously with multiple or complex genetic traits.

Now, as I mentioned, this technology of RFLP mapping with a certain amount of training and a certain amount of experienced personnel, this can be applied to a wide variety of plants and animals of agricultural interest not only in industrialized countries, but also in developing countries. The potential here is simply enormous.

There is an additional advantage in that the improved varieties that you produce in the end are not themselves genetically engineered. This is a case where you use the technology to produce a new variety, which is very, very similar to those that have been produced by other methods in the past, but you do not have to deal with the problems of public perception and fear of the new and the unknown that confront genetic engineers who are actually trying to produce via genetic engineering or recombinant DNA technologies new varieties of crops and animals that I have testified to you about before in conjunction with some of our OTA work. So there are enormous advantages here.

Just to try and place a little bit of perspective on the issue, I think it's the consensus judgment of most people in this area that biotechnological solutions will be evolutionary more often than they will be revolutionary. The magic bullet types of solutions will be the exception rather than the rule.

Furthermore, it is perhaps not realistic to expect the same kinds of quantitative improvements in agricultural productivity that we have seen in the past 40 years.

To let you know exactly what we're looking at, over the past 40 years we have averaged an increase in agricultural production of about 2.4 percent. As we have heard in previous testimony, this has begun to level off in recent years. It is by no means clear that biotechnology will enable us to return to those historical levels, much less exceed them, although in some cases no doubt this will be achieved, but on average that is a much different game. So there certainly are some serious limitations.

One other brief comment. I am also quite optimistic about the potential for biotechnological solutions to be environmentally more benign than some of the methods we have used in the past, particularly those agricultural production schemes that require large inputs.

Mr. SCHEUER. Large inputs of what?

Dr. GIDDINGS. Large inputs of any kinds of outside commodities.

Mr. SCHEUER. You're talking about chemicals?

Dr. GIDDINGS. Chemical inputs with fertilizers which can produce serious problems with downstream runoff and soon, or with herbicides or pesticides for insect control and things like that.

If you can create the plants that will themselves have the capacity to resist insects or herbicides that are important in reducing yield penalties associated with weed infestations, then you can reduce all these extra inputs and you can decrease your costs and increase your yields at the same time. Biotechnology holds substantial potential for improving things along these lines, in addition to the contributions that advances in microbial biotechnology offer us for cleaning up toxic wastes and things like that with newly engineered or selected varieties of microbes especially tailored to perform those sorts of functions.

Mr. SCHEUER. Excuse me.

Dr. GIDDINGS. Sure.

Mr. SCHEUER. This is an extremely important window of opportunity that's there. Are we providing sufficient government support—

Dr. GIDDINGS. No.

[Laughter.]

Mr. SCHEUER.—to maximally encourage just exactly this kind of research and development that has such an enormous payoff?

Dr. GIDDINGS. In my personal and professional opinion, the answer to that question is no. I can also say personally that I am quite pleased with the kind of leadership I have seen you exerting in this Subcommittee because it's obvious that you have been doing your homework in this and related areas, it's obvious that your interest is high and you seem to recognize the kinds of problems and some of the things that need to be done, and it's obvious that steps have been taken both in Congress and by the new Administration to try and move in good directions along these areas.

Mr. SCHEUER. I appreciate everything that you're saying, and I want the record to show that we have had a tremendous showing of interest by both Democratic and Republican Members.

Dr. GIDDINGS. And, fortunately, it seems to be a non- partisan response.

Mr. SCHEUER. Absolutely non-partisan, and I think our dedication and determination to move ahead in these areas is totally nonpartisan.

Dr. GIDDINGS. This is one of the things that makes me hopeful, but I should point out, and my colleagues here know much more about this that I do, that the kind of fundamental research that is needed to enable biotechnology to lead to the advances that we expect and we know are possible in these areas, have been grotesquely underfunded at least by comparison with other biological research over the past two or three decades.

I mentioned this in my testimony, but to briefly summarize, areas such as fundamental plant science, plant physiology and biochemistry, microbial ecology, systems ecology, evolutionary genetics, taxonomy and systematics, all of these areas have been relatively quite underfunded in the past couple of decades, and all of these areas will be vital to enabling genetic engineers and biologists working in these areas to take full advantage of the opportunities that these technologies will afford.

It's obvious that movements are being made to try and increase funding or reallocate funds from one area to another along these sorts of lines, but the difficulties in the face of our current budgetary situation are obvious. So I think many of those in the research communities are disappointed at the rate of progress and would certainly hope for more.

One concluding remark I'll make that we have not heard too much technical talk about this morning, although it has been recognized as an enormous problem, has to do with managing human fertility.

I am not a reproductive physiologist. I am a population geneticist and molecular biologist, but it seems quite clear to me that much as the areas I have just mentioned have been underfunded in the past, reproductive technologies have also been similarly neglected.

You can tell us about the social and political quagmire in which these issues are firmly embedded because of the enormous diversity and extreme polarity of opinions on these issues.

My feeling is, however, that the tools of biotechnology, especially when coupled with fundamental studies in reproductive physiology, genetic regulation and things like that, could lead to the development of contraceptive technologies that would circumvent or satisfy many of the objections that some of the people who have not wanted to see research in this area have objected to in the past.

For example, prostaglandin implants as a contraceptive measure, this is something that certainly answers some of the objections that some people have had against abortion or related family planning methods in the past. Things like that and other advances in this area are certainly possible.

Mr. SCHEUER. Are you speaking of Norplant developed by Rockefeller?

Dr. GIDDINGS. I believe that is one of the trade names. I know of it by the technical term and not the commercial term, I'm sorry. But working with the hormonal messengers that control ovulation in women so that ovulation could be suppressed and so that you never have a fertilized egg and the problems associated with terminating a pregnancy after fertilization that some people object to.

On the other hand, male reproduction is also very complex and affords a number of different ways of potential intervention to manage fertility, and this has been substantially underfunded in the U.S. because of the extreme degree of sensitivity here.

It's not quite clear to me what kinds of research should be funded, but I can make a specific recommendation to you here today about an action which you could take which would be relatively easy to do which could enormously helpful, and I will close with this.

I think there is a very real need for a study in this area to identify the state of scientific advance in these areas and the areas which hold the greatest potential for future contributions in progress.

Mr. SCHEUER. Who would do that study?

Dr. GIDDINGS. Surely you know the answer to this already given my background. I would recommend that you give serious consideration to asking the Office of Technology Assessment to conduct such a study.

Mr. SCHEUER. Well now, just looking at it from the outside, how about the National Science Foundation or the National Academy of Science?

Dr. GIDDINGS. You can do that.

Mr. SCHEUER. There are plenty of places. The National Institutes of Health. I'm being a devil's advocate.

Dr. GIDDINGS. Exactly, and there is good reason to do so. The reason I think OTA is superior to those is all the reasons which give OTA the particular strengths that it has. Anybody else who does it will be perceived as coming from some place that may or may not be associated with a vested interest.

OTA serves the Congress and they will be able to give you this information conscious of the political context in which any discussion of issues and options for Congressional action will have to be considered. Nobody does that as well as OTA does, and I think that no one would be able to do the kind of study that you need in such a way that it would give you the political credibility you will absolutely need in order to take any action following the conduct of the study.

We have seen studies already on these areas carried out by Rockefeller and by NIH and so on and so forth, but what you want is something behind which you will be able to marshal bipartisan support for action, and that's a much trickier job, and only OTA really focuses on approaching it from that point of view.

But you have also got a political problem in getting OTA to do the study in the first place because, to be very blunt about it, an OTA study cannot be done unless it is approved by the Technology Assessment Board. There are individuals on the Board who have very strong opinions on this issue, and this is the reason that OTA has not tackled it in the past, although a study on this issue would be a logical complement to a very successful study that was completed last year on Technologies For Managing Human Infertility-Medical and Social Choices done by the Biological Applications Program.

Mr. SCHEUER. For managing human infertility.

Dr. GIDDINGS. Correct.

Mr. SCHEUER. So the obverse of that, the mirror image of that would be for managing human fertility.

Dr. GIDDINGS. Exactly. The groundwork has been laid, and if the proper approach is made, I think OTA could be persuaded to do a study and I think the TAB could be persuaded to approve such a study, although there may well be a dissenting voice or two.

For the record, I would note that approval from TAB is only required to be a majority vote, meaning 7 out of the 12. So this is something that could be done. It is certainly possible, and I think it's practical to try and approach it.

With that, I will stop and would be happy to take any questions or respond in any other way I might be able to.

[The prepared statement of Dr. Giddings follows:]

Congressional Hearing

Subcommittee on Natural Resuurces, Agricultural Research
and Environment
Committee on Science, Space, and Technology
U.S. House of Representatives
Washington, DC 20515

Hearing on the Food-Population Balance
February, 23 1989; 0900-1300

Testimony of

Luther Val Giddings, Ph.D.
Biotechnology Consultant
Agriculture and Rural Development
The World Bank
1818 H Street, NW
Washington, DC 20433 USA

There is no question that the techniques of modern biotechnology will lead to increases in food production. These are most likely to come through the use of newly improved strains of existing crops, or increased use of previously under-utilized crops, though biotechnology will also make some contributions in terms of more intensive farming methods and techniques. Although much of the coverage in the popular media has been over-optimistic, no reasonable person familiar with biotechnology or agriculture doubts that there is enormous potential here. The more interesting and challenging question is one of those you are exploring with this hearing: Will these increases be sufficient to meet the needs of a global population projected to reach the 10 billion level?

If you want a clear, unambiguous answer to this question, Congressman, you are doomed to disappointment. As other testimony you hear today will suggest, a reasonable and knowledgeable person could defend an answer of either yes or no. Being an agressive optimist, my answer to your question is 'Yes, the productivity increases that will be possible in the next decade or two could feed a world population of 10 billion: it is theoretically possible." But I will be surprised if this happens, because it would require certain things I think are unrealistic or unlikely. But I said I am an optimist, so I will lay out for you some actions that could help narrow the gap between what is and what could be. These fall into two major categories: developments leading to increased food production per se, and developments leading to more effective measures for controlling human fertility. But first some

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brief background.

HOW BIOTECHNOLOGY COULD AID FOOD PRODUCTIVITY INCREASES

Future increases in food production will come both in animal husbandry and the raising of crops. These increases will be based on increases in absolute rates of production as well as improvements in production efficiency. The techniques of modern biotechnology will contribute directly and indirectly, but at the same time advances will come also through incremental improvements to production methods from more traditional or classical approaches, as they have at a regular rate since the end of World War II (U.S. Congress, 1986; USDA, 1986). Advances in production attributable to biotechnology are most likely to be evolutionary, however, rather than revolutionary. Magic bullet solutions will be found, on occasion, but they are likely to be the exception rather than the rule.

One of the elegant new ways in which progress will be made is illustrated by the work of Roger Beachy and his colleagues at Washington University in St. Louis (Abel, et al., 1986). In the course of studying viral diseases of plants, they have produced a technique called engineered viral cross-protection. In a process roughly analogous to animal vaccination, these plant scientists can insert into the plant genome a portion of a viral coat protein gene, which is then incorporated into the host plant's genetic material. Through a mechanism not yet well understood, this

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inhibits the development of disease symptoms in the plant when it is subsequently infected with a virus that would normally weaken or kill the plant, with concomitant losses in yield. As annual losses of food crops to such viral diseases can approach 50% in some tropical countries, the potential for improving productivity is apparent.

An even more powerful source of productivity increases can be found in a technique that is at once more generally applicable, and more easily incorporated into, or grafted onto, existing programs for breeding improved plant and animal varieties. This is called RFLP mapping, or resistance fragment length polymorphism mapping. It is exemplified by the work of scientists at Native Plants Incorporated (NPI) in Salt Lake City Utah (Helentjaris, et al., 1985, 1986; Nienhuis et al., 1987), as well as other groups. This procedure enables biologists to identify genetic markers distributed randomly throughout an organism's genetic material. In the past it was possible to study the effects of genes passed between generations in breeding programs only if they controlled or influenced easily detectable traits such as coat color or seed surface texture. With the ability to follow genetic markers through RFLP technology it is now possible to monitor complex, multi-genic traits, and the genes governing physiological characteristics or biochemical pathways that have hitherto been difficult to study or follow. Better yet, this can be done with cells taken from immature or embryonic offspring from genetic crosses, eliminating the previous need to wait for the issue of a

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test cross to reach maturity. This enormously reduces the time needed to evaluate results. It means that scientists can now combine the powerful tools of modern genetic engineering with sophisticated computer analyses of the results of complicated breeding schemes to produce breeds and cultivars that have been improved with respect to complex genetic traits, or combinations of several traits at once. For example, NPI scientists have identified six genes that have a major impact on flavor in tomatoes. They have used this information to produce a new variety of tomato with enhanced flavor that should be available to growers for the coming season. Similar progress has been achieved with respect to genes controlling water metabolism (which will have an impact on both drought resistance and suitability for canning) and insect resistance. All this has been accomplished simply by monitoring and selecting the results of test crosses with these new information technologies. No genetic engineering of the tomato plant, per se, was involved. Similar work is being pursued with corn, cabbage, onion, sugarbeets, roses, azalea, alfalfa, and other plants. Such work is not yet far advanced with any agricultural animal, however, although the potential for advances is similar.

The beauty of this technology is that it is a straightforward matter to apply it to almost any plant or animal that can be bred in captivity. Once the genetic markers are identified, they can be used as tools to monitor and manipulate selective breeding programs to take full advantage of the existing pools of genetic variation in agricultural species. This should enhance the

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effectiveness and speed the progress of a wide variety of breeding programs. Additional improvements in productivity can be expected to follow from basic research in gene regulation and developmental biology that will lead to advances in our understanding of these critical subject areas (NRC, 1985). It is pleasing to note the recent announcement by the Secretary of the USDA of a program of gene mapping and sequencing plants of economic importance in the U.S. (MacKenzie et al., 1989; Rensberger, 1989).

THE FOOD SUPPLY AND PRODUCTIVITY INCREASES DUE TO BIOTECHNOLOGY

Many discussions of the degree to which the new biotechnologies could contribute to productivity increases fail to take proper note of the enormous gains in agricultural productivity over the past 40 years. Since 1950 world agricultural output has increased at a compound annual rate of 2.43% (USDA, 1986). It is by no means certain that advances in biotechnology will be sufficient to maintain this rate, let alone improve upon it. Indeed, the type of research that might be expected to lead to the qualitative improvements in agricultural efficiency that would be required are relatively underfunded; research into means of improving photosynthetic efficiency in plants, for example (Buttel, 1989; NRC, 1985, 1987; U.S. Congress, 1988).

Even if these historical rates of productivity increases are matched, however, it is no guarantee that those who need food will receive it. Some theorists argue that there is no world population

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problem because global agricultural production is sufficient to feed the existing population. Aside from debates over how palatable such a theoretically attainable diet would prove, to argue thus ignores certain realities: the global distribution network does not distribute this production equitably or effectively. And no one has proposed any reasonable or realistic measures to improve this system that do not crumble into insignificance when faced by a doubling of world population over the next 20 odd years. In other words, the challenge of feeding a world population twice its present size is not simply a scientific challenge subject to a technological fix if enough research dollars are devoted to the right projects. On the other hand, few knowledgeable people hold any hope for dealing with the situation unless appropriate research investments are made.

An additional problem should also be noted. While the new biotechnologies will certainly enable progress, especially in terms of streamlining and facilitating traditional selection and breeding programs, it cannot be overlooked that many of the 'improvements' brought about by such breeding programs will impose additional energetic burdens on the plants or animals involved (Bhatia & Mitra, 1988). This means that to increase product output, energy and material inputs into the producing system will also need to be increased. It is not likely that this will be as easy to do in the future as it has been in the past. The difficulties are underlined when one realizes that energy committed to agricultural production

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increased between 1950 and 1985 by almost a factor of seven (Brown, et al., 1987: Krahl & Cook, 1988).

BIOTECHNOLOGY AND THE ENVIRONMENT

"While factors other than population growth affect the environment, population growth compounds these effects" (Krahl & Cook, 1988). The prospect that advances in biotechnology might break, or at least attenuate the cycle of positive feedback between the problems of population growth and environmental degradation has not been thoroughly explored to date. There are several promising indications, however. Contributions might come in at least two general areas: production of plants (both food crops and trees) better able to resist drought, saline, or other environmental stresses such as extremes of temperature or poor soil quality; and the replacement of existing agricultural practices with developments or refinements that are more environmentally benign. An example of the latter might be found if the generation of crops resistant to environmentally acceptable herbicides leads to retiring from use those herbicides that are more persistent or toxic.

Biotechnology could be something of a two edged sword here, however: not all that is possible with biotechnology will be environmentally benign. In fact, negative environmental consequences could well result from poorly thought out applications of the new technologies, although it is not reasonable to view

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these as intrinsic to use of the technologies per se. But it is clear that some things that might initially sound attractive or useful, if possible, are not necessarily to be sought after by those concerned with long term solutions to global problems. Forage grasses capable of flourishing in poor tropical soils, for example, would enable more tropical rainforest to be converted to cattle pastures with slightly less destructive results than at present. But the last thing we need are any further stimuli for cattle farming in the tropics, as they are among the least efficient converters of plant biomass to animal protein, independent of the irreperable harm being done to tropical rainforests.

BIOTECHNOLOGY AND HUMAN FERTILITY

One area in which valuable contributions from biotechnology might be anticipated is in the management of human fertility. There is an urgent need for appropriate contraceptive technologies, particularly ones that could be coupled with advances in child care in developing countries that would help break the link between fertility and immediate economic advantage. This is an area that has been disproportionately underfunded in industrial countries, especially in the past eight years, as U.S. policy in this area has been coopted by individuals holding a narrow, sectarian point of view that neither represents American public opinion at large nor reflects a rational assessment of global realities. There is a clear opportunity for Congress to act in this area to take

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advantage of enormous possibilities for progress.

WHAT CAN CONGRESS DO?

1. Work with the administration to establish a bipartisan U.S. Policy that exerts the needed leadership in important areas such as fundamental biological research, applied research, population policy, and technology transfer.

This is easier said than done, of course, but any motion in the right directions would be likely to improve the existing situation.

2. Act to ensure that fundamental research in plant and animal science is being supported at appropriate levels.

Certain aspects of fundamental research that are relevant to the issues of concern in this hearing have been disproportionately uderfunded over the past three decades. Fortunately, these also overlap considerably with the areas in need of increased research support to ensure the safety of planned introductions of genetically engineered organisms, a topic on which I have testified before you on other occasions. Particularly worthy of increased support are fundamental plant science, gene regulation, ecology, both of systems and of

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microbial populations, and evolutionary biology, which cuts across all interdisciplinary and organismal borders.

One of the most effective actions Congress could take would be to reallocate some monies from less productive programs at USDA (not difficult to identify) to the more productive, highly regarded, peer-reviewed Competitive Grants research program.

Act to ensure that the opportuntity to develop new, more acceptable and applicable methods of human contraception does not slip away.

This is perhaps the easiest thing for this committee to do to make a positive contribution to dealing with the problem under discussion here today. The path of action, i.e., what research to fund, is not at all clear. But the Office of Technology Assessment has recently produced a sterling study of problems in combatting human infertility (U.S. Congress, 1988); it would be most logical to follow this up with the complementary study, which is sorely lacking: challenges to controlling human fertility. This committee could then have confidence that the information received would provide a critical, unbiased, non-partisan outline of the challenges, problems, and opportunities involved in this most important area at the intersection of science and government policy.

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Mr. SCHEUER. Dr. Giddings, you certainly have ended your testimony on an upbeat note, and we will be in touch with you about this very interesting suggestion you have made.

Dr. GIDDINGS. My colleagues at OTA may not appreciate my having made it, but since I no longer speak for OTA, I feel free to—

Mr. SCHEUER. You're speaking here as an individual and none of your views will be ascribed, isn't that the usual commercial, that none of your views will be ascribed to your organization.

Dr. GIDDINGS. Thank you.

Mr. SCHEUER. Can the high-technology methods of food production that you have discussed, the applications of genetic engineering, can they be implemented in developing countries or will they mostly be appropriate and practical in countries where technical and natural resources, capital and scientific expertise are abundant? Are these capital intensive investments that are really not relevant to the developing world? Can these investments be made to develop seeds and species and so forth that then can be provided to the developing world the way Dr. Chandler did in his Philippine Institute?

Dr. GIDDINGS. This is an excellent question, and it's a very complicated one, much easier to ask than to answer, but—

Mr. SCHEUER. We specialize in those kinds of questions.

[Laughter.]

Dr. GIDDINGS. You've done this to me before. Thank you.

[Laughter.]

But let me try and respond meaningfully. This technology is not really capital intensive so much as it is expertise intensive, and while there are certainly developing countries that have the expertise now to apply this in spades, and Thailand comes to mind, India is another, Taiwan is a superlative example, there are developing countries or newly industrialized countries for whom there are virtually no barriers to implementation of these tools. There are also countries who do not have people trained in fundamental biology much less recombinant DNA techniques, and it will be very difficult to apply some of these sorts of techniques on the ground in those countries. As we have heard earlier, and has been demonstrated in other contexts, this is certainly desirable where possible.

This is something the Bank is exploring right now because this will obviously be important. There are regional Agricultural Development Research Centers which can pick up some of the slack here, but this is a challenge that will have to be faced by those interested in applying this technology because the way things are organized right now it is unfortunately all too probable that the countries most in need of the advances that these technologies might bring might wind up paying, at least early on, a disproportionate share of the costs.

I can illustrate that with an example. Most of the research that is being done in the U.S. and in industrial countries is aimed at producing industrial substitutes for agricultural commodities.

Mr. SCHEUER. Elaborate on that.

Dr. GIDDINGS. For example, replacements for sugar, and if you produce especially a low calorie replacement for dietary sugar, you have delivered a death blow to the economies not only of the great

State of Hawaii, but to the Philippines and the Caribbean countries and so on because sugar is one of their major cash crop exports. And if you think the balance of payments in those countries is bad now, wait and see what happens when you eliminate sugar cane. These kinds of developments are among the ones that may be fairly early.

On the other hand, the development of new crop varieties that are intrinsically resistant to insect predation or post-harvest loss to rodents or insects or fungal diseases and so on and so forth, that would be an enormous advantage to a small farmer in a developing country who does not have the cash to spend on chemical fertilizer supplements and so on and so forth.

So the benefits to these developing countries are potentially very great also. It's going to require some intelligent intervention and planning on the part of organizations that can have an impact on the development and application of these technologies to make sure they are applied in a wise way. The challenge is formidable.

Dr. CHANDLER. May I just mention one thing, Mr. Chairman, regarding this same subject.

Mr. SCHEUER. Certainly.

Dr. CHANDLER. The Rockefeller Foundation in their agricultural science program is supporting biotechnology work with rice in Europe, in the USA, in Australia, wherever they can find the expertise to do it. The idea is that they will create these innovations, and they will be given to the International Rice Research Institute for rice, for example, where they will develop varieties incorporating these qualities, and then they will go out to the less developed countries where they will be especially adapted to the local conditions.

This, I think, is going to have its impact with time and at least stabilize yields at high levels, if not increase them somewhat more as well.

Dr. GIDDINGS. I would agree.

Mr. SCHEUER. Well, this has been a most stimulating and most productive hearing, and I wish we had another couple of hours to continue, but we don't. There is another hearing that is about to move into here. So we have come to the end of this morning's hearing.

I can't thank you all enough for what has been a truly thoughtful and creative and productive hearing. Thank you very much.

The hearing is adjourned.

[Whereupon, at 12:45 p.m., the Subcommittee adjourned, subject to the call of the Chair.]

OVERVIEW OF THE GLOBAL FOOD AND POPULATION SITUATION

TUESDAY, FEBRUARY 28, 1989

U.S. HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE
RESEARCH AND ENVIRONMENT,
Washington, D. C.

The subcommittee met at 9:20 a.m. in Room 2325 of the Rayburn House Office Building, the Honorable James H. Scheuer, chairman of the subcommittee, presiding.

Present: Representatives Scheuer, Tanner, Skaggs, Schneider and Smith.

Mr. SCHEUER. The second day of hearings on the whole painful conundrum of equilibrium between population and food resources will come to order.

Let me first introduce my colleagues. We are joined on the right, on the Democratic side, by David Skaggs of Colorado and John Tanner of Tennessee, one of our great new freshman members, and by another great freshman member from the Republican Party, Lamar Smith of Texas. I use those party designations for identification only. This is a totally nonpartisan committee. We are not only bipartisan, we are bicameral, and we welcome Senators over here of either party, and we work with the Senate very, very well. I am delighted my colleagues are here.

Because of the number of Congressmen up here and because of the number of witnesses, I am going to impose a strict five-minute rule on all of us up here, including the chairman. He, in particular, finds that very painful, but in deference to my colleagues and in deference to all of the witnesses, I think that is what we are going to have to do, and it is a tribute to my colleagues for their interest and their presence in being here.

Well, now you have been joined by Claudine Schneider; you have doubled your representation over here.

All kidding aside, Congressman Smith, we are delighted to have you here, and we are delighted to have the ranking member of this subcommittee, who has been so involved in all of these matters, who has worked so hard, Congresswoman Claudine Schneider of Rhode Island.

Well, we are delighted you are here, and we look forward to working with you over the years, Lamar.

All right. In the opening day of the hearing, we heard testimony from agricultural scientists and commodity analysts who predicted that we will be able to meet the world's nutritional demands, several of them did, and these predictions were based on the fact that for the last 40 years, the world harvest has risen steadily, in part, due to the remarkable success of the green revolution in Asia; however, the implications of the green revolution and the environmental crises which they have produced have led others to question the assumption that food production will necessarily continue to meet world needs. Some of the environmental problems that are looming up ahead will increase the loss of tropical rain forests, the rising level of greenhouse gases that are generating this awesome decrease in the ozone, the pollution of groundwater by hazardous wastes and ever-increasing reliance on nonrenewable forms of energy, that is, forms of energy that can't be replenished.

If I want to ingratiate myself with a Congressman, any Congressman anywhere in this country, I say, "How would you like to do something with me in your district on the problem of groundwater? I don't even have to know what district he represents; I can fly blind, because every single Member of Congress has a problem of groundwater. It comes under the jurisdiction of this committee.

Second, compounding the problem are the demands of burgeoning regional populations which clearly will exacerbate existing environmental problems and undoubtedly contribute in some areas of the world like the Middle East to political instability, as precious natural resources such as water are stretched to their limit and beyond their limit, and we will hear from Dr. Starr on this question very soon.

One of the other regions of environmental insanity is Brazil, where the needs of Brazil for farming space and for cash crops to export and, in this case, lumber, are having a devastating effect on the population of the Amazon Basin.

Well, all right. I guess that is the end of my statement.

Let me, since it is my opening statement, abuse your patience for another moment or two. In Brazil, the slash and burn agricultural techniques have resulted in a loss of about 8 million hectares a year, and that is an area annually lost of tropical rain forest equal to the state of Austria. Imagine that.

I read in last Sunday's Times on the front page that now there's a plan to bring in—to create a $300 million railroad that the Japanese are thinking of sponsoring, so that they will have a direct route from the Amazon Basin of tropical rain forests right to the Pacific ports, whereby that lumber can be transported by ship to Japan.

Doesn't that make it incumbent for the developed nations, as we help the developing nations, to think about some kind of standards of responsibility that they would accept in financing a railroad like this, that Japan might think about, as well as locking in the developing countries to a mutually applicable higher standard of environmental behavior? Is there some way that we can engage Japan and other development countries in some kind of a global agreement on helping Third World countries manage their debt in exchange for accepting a higher standard of environmental behavior? That is the debt-for-nature swaps that we have heard so much about.

So it seems to me that it is perfectly clear that countries like Brazil have to develop their natural resources. They will develop their natural resources. They need to develop their natural resources, but what they need, as well as what we need, is that they do it on a sustainable basis, because otherwise they are going to kill the goose that laid the golden egg, and they won't have that resource to develop and exploit, sustainably, and there will be a devastating effect on biological diversity, and the whole world will be poorer.

So what we are really going to talk about today is the environmental consequences of unrestricted growth, and our distinguished witnesses will give us questions for moderating environmental destructive activities and developing models of development that will provide for sustainable development. That is the key that we are all looking for.

Mrs. Waafus Ofusu-Amaah, at my right of the panel and the audience's left, will talk to us about the pivotal role that women are playing in agriculture and sustainable development and the critical social pressures which favor large families in resource-poor regions.

All right. Can I yield to my distinguished minority ranking member.

Ms. SCHNEIDER. Thank you, Mr. Chairman. I commend you for once again this year convening what I consider to be one of the most important hearings that we will be holding on a way in which we can better address some of the issues and the implications that reach far beyond just the topic that we are covering today. The imbalance between our food and population on a global scale is a crisis that will have serious consequences for all of the countries of the world, if it is not corrected.

I would like to focus just a few of my comments on the population side of the equation, because right now, we are facing a growing crisis in world population growth, and last year the world's population increased by 90 million. Most of that increase occurred in developing countries, precisely those countries that are least equipped with the information and oftentimes the technology to accommodate these surging numbers. One of the major environmental threats that unrestrained population growth has worsened is global warming. As we will be saying, the tropical rain forests are destroyed right now at an unprecedented rate through a slash and burn agricultural technique. Regrettably, women throughout the world are the primary food raisers. They, primarily, are responsible for the slash and burn technique. I have learned, hands on or in close communication with many of those farming women, that it is not because they choose to do farming that way, but it is because they have not had access to other information, as our foreign aid program provides agricultural information for those who can read. And women, of course, are the most illiterate of the world. Of the 800 million illiterate people in the world, 600 million of them happen to be women.

So it is critical that we, in our policies, make sure that we get to the root of the problem and if, indeed, women are, in terms of their techniques in destroying our tropical rain forests, then we have to be more actively focused in our policies.

Furthermore, greater population sizes lead to greater energy consumption, delivering a double blow to our very fragile atmosphere.

That is why I have introduced my bill which also addresses population growth. The bill is the Global Warming bill I introduced into Congress last week. Title XI would establish a national policy that family planning services should be made available to all persons. Funding would be provided for this purpose, including a substantial set aside for the United Nations Population Fund. Use of such services would be on a strictly voluntary basis. Nevertheless, according to the Population Institute, a major social science survey indicated that 1.5 billion people in the developing world would like to limit their family size but either could not get or could not afford contraceptives. This is the information that I have personally received, particularly in Africa. I think that it is our personal and governmental responsibility to provide that information.

I also would like to indicate that as we look at the challenges of population and growth and the providing of food for those populations, granted all of those pressures on the earth, as the Chairman had indicated through hearings that we held in the past, do put added pressures overall on the planet, and global warming is one of those side effects, a side effect that will not easily be remedied, unless there is unified effort. And that means not only every country in the world, but it means both men and women.

On that note, I welcome the women who are here to testify. All too rare is it that we do have women testify before any committee in Congress. Let me say to Ms. Ofusu- Amaah that I am a member of the Board of WorldWIDE, and I commend you for your work. I have heard of you frequently. This is my first opportunity to meet you, and I regret that I will not be able to stay here and personally hear the testimony of each of you, but my very able staff person and others are going to be covering this for me.

I am running over to the White House, because I feel that it is important to share with the administration some of the things that will be discussed here this morning, including the role of women, the impact of population on our planet and what we can do and what the administration can do in terms of dealing with the global warming trend.

So on that note, I welcome you, but I also must bid adieu. Thank you.

Mr. SCHEUER. All right. Thank you very, very much, Madam Ranking Minority Member.

John Tanner of Tennessee. Congressman John Tanner.

Mr. TANNER. Thank you, Mr. Chairman. I too am delighted to be here this morning. I apologize for not being at the previous meeting of the subcommittee, and I would just like to add my welcome this morning and look forward to hearing from all of you. Thank you, Mr. Chairman.

Mr. SCHEUER. Very good. Thank you. Congressman Lamar Smith.

Mr. SMITH. No opening comments.

Mr. SCHEUER. Congressman David Skaggs.

Mr. SKAGGS. Thank you, Mr. Chairman. I don't have an opening statement. It is a real pleasure to join your subcommittee.

Mr. SCHEUER. Great. I am delighted you are all here.

All right. Why don't we start with Dr. Joyce Starr, who founded the Near East Studies Program at the Center for Strategic and International Studies. She worked there from 1979 to 1988. She was recently named Senior Associate at the Center and codirector of a major Middle East project for the American Academy of Arts and Sciences.

All right, Dr. Starr. Let us hear from you. Why don't you take your five or six minutes, and then we will proceed with the rest of the panel, and I am sure we will have some questions for you. We may, from time to time to time, interrupt with a statement, but we will try to let each of you finish and then we will address questions for all of you.

STATEMENT OF DR. JOYCE R. STARR, COCHAIRMAN, U.S. GLOBAL STRATEGY COUNCIL.

Dr. **Starr**. Thank you, Congressman Scheuer.

Mr. **Scheuer**. Let me say—excuse me, Dr. Starr—for all of you that your prepared statements will be printed in full in the record. So you can simply chat with us informally. Please proceed.

Dr. **Starr**. Congressman Scheuer, for the record, in addition to my pleasure to being here, I am representing the United States Global Strategy Council. I am cochairman of that Council. It is chaired by Ray Cline, and we are very proud of the commitment that the USGSC has made to the environmental issues of this country.

I want to begin by saying that sewage is not sexy, but it is strategic. Salinity isn't stimulating, but it is strategic.

Congressman Scheuer asked me in the invitation to appear before you to talk about U.S. strategic interests. I have been doing that for the last decade, but it is very hard to elicit from Members of Congress a great interest in water- related issues, because they say to themselves, well, how does this compare to MX missiles or weaponry of major magnitude, global warming, et cetera?

Well, water, I think, is an imperative issue. Where I come from in the Midwest, they used to say, we know two things. One is that we are not going to spend very long on this earth, and the second thing is that most of us are going to have to pay taxes. There is a third thing we know, and that is that the world does not have enough water for the population that we have today, not enough water to drink, not enough water for agriculture, not enough water for industry. The world is going to need, by the year 2000, $180 billion in new investments simply to meet the basic water needs of the world population, and we don't have $180 billion to invest. We know that the CIA has targeted approximately ten spots in the world where war could break out over water. Most of them are in my area of specialty, and that is the Middle East. Israel and Jordan, Jordan and Syria, Israel and Syria, Syria and Turkey, Iraq and Syria. It goes on.

Water is a conflict issue. We may bring the Israelis and the Jordanians and the West Bankers and the Gazans and even the Syrians to a peace process. It may begin, and it may completely break down over the issue of water. Today the Gaza Strip is a time bomb waiting to explode. Within a few years, Gaza will have no potable water. Israel will have to supply that water, and you can be sure that the Israelis will not be eager to supply the Gazans with water regardless of the settlement of the peace process, because Israel, Jordan and the West Bank will have a 30 percent deficiency in water by 1995. And what I am talking about in reference to the Middle East could be Africa, it could be Latin America, it could be so many regions of the world, but the Middle East is a good model, and that is what my paper is about and that will be submitted for the record.

I think that one of the greatest frustrations that Members of Congress and those who testify before them have is that we provide figures and facts, and it is also frightening and awesome, but we say, well, what can we really do about it? It's really beyond our control.

It's not beyond our control. The United States Government can do a great deal about global water scarcity. It turns out I did a report that was issued last year, "U.S. Foreign Policy on Water Resources in the Middle East," evaluating each agency of the U.S. Government and what each agency was actually able to do and doing about water resources. I found that there were an awful lot of unsung heroes in our government. They were not only behind the scenes, they were way behind the scenes! They were people who had devoted their lives to this issue and had a great deal to offer.

But the problem is that we have no real strategic organizational structure oriented to water scarcity. The Department of Defense, ladies and gentlemen, doesn't have a single individual at a primary level dealing with water scarcity. The only thing that we do in the Department of Defense today on water scarcity is deal with the issue of how we get water to our troops. We do not connect it to the issue of water conflict worldwide. But yet it is clearly a strategic and even a defense-related issue.

Mr. SCHEUER. Does our CIA think about water conflict potential worldwide?

Dr. STARR. Yes. It has been thinking about it for quite some time, actually.

Mr. SCHEUER. Presumably, they are advising and consulting with the Department of Defense?

Dr. STARR. Presumably. But nonetheless, there is no one in the Department that has responsibility for this issue. I believe that it is paramount that we have—and I have put that in my report—the capability to have firsthand data computerized in our government. Not only the U.S. Government, but the World Bank does not have a computer data system that tracks water-related issues and data acquisition.

For example, if we want to know the problems of water in Jordan or Israel in 1989, we will go to the Israelis and Jordanians and ask them for their figures. They will give us their figures. We want to go back two years later, we have to go back again and do the report all over, because the figures are not in a computer. We have no way to access that data and to continuously update that data. It is not that expensive. We are talking about very little money to give us the ability to monitor. And the World Bank doesn't have the data either. That is what is absolutely remarkable. The UN doesn't have the data. No one has the data. Each agency might have—I mean, the United States Government, the World Bank, the UN may have a little bit of data on some problems, but there is nowhere that we can easily access and describe what is happening in the world today.

Mr. **Scheuer**. Excuse me. I am going to try not to interrupt, but tell me from your point of view at the mountaintop, where would the most logical place be for vesting that responsibility, for collating all the data and organizing the data, so it is really a comprehensive, integrated body of data?

Dr. **Starr**. I believe that it should be State Department/AID. It should be a joint effort between State Department and AID. It should not be lost in another agency. It should be dealt with on a foreign policy level, and foreign policy means State Department, and it means AID, because AID is the one that is trying to extend our arm to the world.

I believe that the United States has tremendous capability to alleviate the problem. You-all from Texas and other southern states know that we have been dealing with water in this country from day one. We have some of the top people in the world. Most of them don't have passports. Most of them don't export their capability. They don't export their capability. They don't know how to deal with the rest of the world in the water industry. I would say at least 80 percent of them are dealing at home but not worldwide. We have the power and the potential to bring people from Africa, all over the world, to help train them in maintenance of equipment, to help train them in technology that would create breakthroughs in desalinization and other areas. We will never increase the amount of water that we have. I mean, there won't be more water, but we can deal with the water levels that we have. We can clear up the water. We can clean the water, and with desalinization and breakthroughs in desal, we may even be able to use seawater on a general wide basis which we can't do today, because it is far too expensive.

I believe that there are many things that our government can do, but first and foremost we can take a leadership role, which we have not done. I was really quite impressed by Congressman Scheuer's interest in this subject. After several years scouting around the Hill, I could find very few Members of Congress that really had the global vision to understand that water problems were not only U.S.-related, you know, Arizona or Texas or California, but that we were all an integrated unit—United States, Africa, the Middle East, Latin America.

Thank you very much.

[The prepared statement of Dr. Starr follows.]

"GLOBAL WATER SCARCITY: THE MIDDLE EAST AS A CASE STUDY"

TESTIMONY

before the

Subcommittee on Natural Resources,
Agriculture Research and Environment

by

Joyce R. Starr, Ph.D.
Co-Chairman
U.S. Global Strategy Council

February 28, 1989

Portions of this testimony have been excerpted from Dr. Starr's Panel Report, U.S. Foreign Policy on Water Resources in the Middle East, 1987, published by the Center for Strategic and International Studies, Washington, D.C.

By the year 2000, water will emerge as a more precious commodity than oil. The dimensions of the looming global water crisis are staggering. According to the World Bank's most conservative estimates, the world will require $180 billion in new investments by 1990 to meet the decade's requirements. Yet, like an animal blinded by a car's headlights, we find ourselves immobilized before the dangers that lay ahead.

Action must be taken now to avert the all too familiar cycle of bureaucratic inertia followed by crisis reaction, the accompanying stopgap solutions, and the costly adjustments to political and economic shocks. The Global 2000 report points out that between 1970 and 2000, population growth alone will double the need for water in nearly half the world.

Failure to adequately manage water supply and demand could have devastating consequences for world stability and order, and for U.S. interests. Indeed, the U.S. government has recently targeted 10 locations worldwide where state-to-state conflict would be most likely to occur over scarce and inadequate water resources. More than half are in the Middle East region, including: Israel and Syria; Syria and Turkey; Iraq and Syria; Israel and Jordan; Jordan and Syria; Egypt and Ethiopia.

According to the Worldwatch Institute, "despite modern technology and feats of engineering, a secure water future for much of the world remains elusive." Nowhere is this prognosis

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more true than in the Near East--Jordan, Israel, Syria, Egypt and the West Bank/Gaza--where emerging water shortages are creating a situation of crisis proportions.

Israel alone is currently using 95% of all renewable water resources and consumes five times more water per capita than its neighbors. The Jordan River has been so highly developed in recent years that it is now a limited resource. World Bank officials predict that Jordan, Israel and the West Bank will deplete all renewable sources by 1995 unless remedial measures are taken quickly.

Syria's overly ambitious agricultural development plans and the mismanagement of water-related infrastructures are already creating shortages of water and the rationing of electricity in major cities. Egypt's burgeoning population (which is expected to increase by 15 million to almost 70 million in the next 12 to 15 years) will place critical strains on the Nile in the years ahead.

Many irrigation schemes in the region are so poorly designed and maintained that rising salinity levels in the soil are forcing the abandonment of valuable farmland. And throughout the area underground water supplies are being contaminated by inadequate and poorly managed sewage facilities.

I. The Nile River

A decade of drought in East Africa has begun to affect the waters of the Nile, literally Egypt's life line. The river provides 86% of the 158 billion gallons of water used in Egypt each year. Last summer, the Nile dropped to its lowest point in a century, forcing Egyptian authorities to turn to Lake Nasser reserves to relieve the desperate water situation. Lake levels dropped nearly 500 feet before August floods provided some relief. The potential for unrest amongst the 51 million Egyptians living along the Nile was thereby calmed, if only temporarily. Many geographers predict that, were the drought to resume next summer, resulting power cuts would wreak havoc with Egypt's already limited industrial output.

Egypt is not alone is its life-or-death dependency upon the free flowing Nile waters. Changes in water flow upstream eventually affect the Egyptians downstream. Since the 19th century, numerous agreements have been concluded (often with the involvement of Great Britain) concerning the usage of Nile waters. Common to these agreements were clauses prohibiting upper river riparians from impairing the flow of the Nile to the detriment of those downstream, and articles strengthening rights and equitable sharing of the Nile.

A 1959 agreement established a definite regime for the Nile, providing for the full utilization of the river. The Sudan also agreed to allow the construction of the Aswan Dam. A permanent Joint Commission was established through which Egypt and the Sudan could articulate a unified position on issues concerning Nile basin development.

Unfortunately, no single agreement yet exists binding all of the Nile riparians. Upper river riparians generally disagree with downstream riparians over use of the river. During the 1986 UNDP Workshop for Nile Basin Countries held in Bangkok, however, riparian states called for cooperation in determining the equitable allocation of Nile waters. They also agreed to seek the assistance of the UNDP in creating a Nile development program. Population increases in the riparian states over the next decade will require revisions to the allocations established in the 1959 agreement.

In general, future agreements will reflect the growing demand placed on the Nile by the riparians (especially upstream), many of whom are only now beginning to formulate in general terms their development plans. Ethiopia remains the "great unknown" of the Nile Basin and will assume a more dominant role in coming decade. Dr. John Waterbury of Princeton University estimates that Ethiopia supplies more than 82 percent of the Nile's water. Given this preeminent position, development plans undertaken by Ethiopia--such as irrigation schemes in the Blue Nile Basin and the Baro--could have a direct and deleterious impact on Egypt and the Sudan.

II. The Tigris/Euphrates Rivers Basin

Turkey is generously endowed with water resources. The Euphrates River Basin has a total water potential of 35.5 bcm per annum, 31.5 bcm of which are generated in Turkey. The

Tigris River Basin has a potential of 48.6 bcm per annum, 25.5 bcm of which are generated in Turkey.

The South East Anatolia Project is comprised of a series of thirteen irrigation and hydroelectric projects that will attempt to captialize on this potential in seven of Turkey's southeastern provinces: seven projects on the Euphrates River and six on the Tigris. The irrigation projects are especially important in light of the fact that 40 percent of the aeroble land in Turkey is in southeastern Anatolia where there is a general shortage of water. Upon completion, the project will supply approximately 24 billion kwh of energy (almost half of Turkey's current needs) and open 1.6 million hectares of land to irrigated cultivation. The Turkish government hopes to sell the additional food production to Europe and the Middle East, which is expected to import $20 billion worth of foodstuffs by the end of the century.

Turkish officials hope to stimulate economic growth in an area where a large portion of the population is living under unacceptably low social and economic conditions. Dr. Rhode, a member of the intelligence staff of the Department of State, has noted however that Syria's electricity generating capabilities may diminish as a result of a reduction in the flow of the river. Also, the Anatolia Project will give rise to new concerns about the allocation of the river's waters, thereby heightening current tensions among the riparians.

Syria has recently experienced just how the Turkish Project can be used to its detriment. In the belief that Syria has supported Armenian terrorists against Turkish interests, Turkey has "punished" Syria by cutting back the water flow to Syria's hydroelectric Assad Dam. In response, Syria began drawing a greater amount of water from the Eupharates than usual for its irrigation and hydroelectric needs.

Iraq has long feared the effect of Syrian development schemes on the Euphrates. Now it is concerned that development schemes in Turkey (including the massive Ataturk Dam) could reduce the annual flow of the Euphrates into Iraq by more than 50%. The above scenario has served to validate these fears.

Unfortunately, there is still no clear agreement among the riparians regarding water allocations: the Trilateral Commission on the Euphrates River (Turkey, Syria and Iraq) has discussed only technical matters, such as data concerning river flow and rain fall amounts. Further, because Turkey regards the Tigris and Euphrates rivers as one basin and Iraq treats them as separate entities, the difference in definition could prove an obstacle to finalizing any future water agreement.

Recent talks in November between ministers from the three countries concluded after a technical committee was appointed to draw up guidelines for future water sharing. This issue will take on particular significance in 1992 when the dam comes on stream. Talks are scheduled to resume in April of 1989.

III. Jordan River Valley

Rising standards of living and increasing birth rates are placing new strains on the Jordan; by the year 2000, water consumption in Israel and Jordan combined will increase by 30 percent. Improvements in desalination technology will increase the amounts of water available to riparian states. The development and sale of high-value crops could also alleviate the costs of developing and employing desalination technologies. High value crops, however, will truly be effective only if they both meet the food requirements of the region and can be marketed to other countries.

Water resources of Israel, Jordan, and the West Bank total a mere 2.5 bcm, with only modest gains expected in the coming decades. Hence, efforts must be made to improve water managagement techniques and to develop more cost-effective technologies. There is a close relationship between the development of these technologies and energy costs. In addition, questions of water allocation and control will have a direct impact on West Bank autonomy negotiations. The general shortage of water will be a key determinant of the number of people that can live in the West Bank, and will thus constrain the overall effectiveness of development plans for the area.

Further, to meet future needs, Jordan will pump increasingly larger amounts of water from the Jordan Valley and rely more extensively on water reuse. Farmers will have to make better use of drip irrigation technologies. This will become more expensive due to the need to treat brackish and salt water, and the increasing distances water must be pumped to reach consumers. Although it is technically possible for Jordan to pump water from the Euphrates, it is not economically viable in the long run.

A joint Jordanian-Syrian project for the Yarmuk has recently been announced. The $400 million project seeks to provide the Syria with hydro-electricity, and Jordan with more adequate water supplies to fill its irrigation needs. Ultimately though, the project could serve to place Syria in a power-play position over Jordan's agricultural water needs. Furthermore, the Yarmuk project could affect Israeli water needs, as the Yarmuk is a vital source of the Jordan River, upon which Israel and the territories are increasingly dependent. The Israelis maintain that the proposed Dam would deprive them of 70 MCM of water annually and increase the salinity of the Jordan River.

IV. Israel's Water Concerns

By the turn of the century, Israel's water needs may exceed supply by 30%. Some experts believe that by 1995, Israel will have fully developed all renewable water resources and will reach a critical point in the exploitation of non-renewable water supplies (those which cannot be naturally replenished.)

With current annual water usage at 1759 MCM, Israel is leaving itself a shallow cushion of under 100 MCM. Severe drought could easily upset this precarious balance as was shown in the late 1970's when ground water supplies became tainted by salinity during a prolonged dry spell. If the experts' predictions are accurate, it seems that Israel is pursuing a collision course with dessication.

High consumption of water in Israel is a function of Israel's intensive agriculture and industrialization. Culture also plays a role, since Israelis tend to behave more like Europeans than natives of the Middle East. Israel is presently overdrafting its water resources at fifty per cent beyond their natural replenishment rate, causing water table levels to drop and shallow wells to go dry.

Of Israel's annual water budget, approximately seventy-five percent goes to agriculture. In the view of some experts, cotton production is a glaring example of systemic water waste. Not only is the world cotton market heavily saturated, but cotton production receives large government subsidies and requires enormous amounts of water, only to yield paltry returns. Hebrew University Professor Hillel Shuval likens cotton exportation to exporting water and has called for drastic cuts in production.

Pollution exacerbates the Israeli water crisis. Untreated sewage, especially in Arab areas, and improper handling of city refuse are the major problems. Often situated above or close to water sources, seepage from these pollutants are cause for deep concern.

V. Water Needs in West Bank and Gaza

Lost in an atmosphere of politically-spawned drought, the territories of the West Bank and Gaza suffer particular water difficulties. Both regions are quite arid, yet the politics of occupation have in fact exacerbated an already difficult situation, making it more severe. Water allocations to the Jewish settlers of the West Bank, for example, far exceed proportionately those destined for Arab populations. Meron Benvenisti writes in The West Bank Handbook that the Israeli water authorities plan to direct 137 mcm per year to the Arab population on the West Bank, (about 1 million people) by the end of the decade, and 100 mcm to the settler population (100,000 people) during that same period.

The Palestinians, for their part, cite the constant refusal of their requests to dig wells and complain that Israeli settlements receive the greater share of existing water resources. They further contend that they are denied access to groundwater--actions that force them to depend instead on unreliable rainfall.

Palestinian sources suggest that the Israelis have dug some 26 or 27 wells since 1967, but none of the newly acquired water has been allocated for Arab use. In fact, they state, Israel has sold water to West Bank Arabs only when drought conditions proved to be particularly severe, and then at three times the price of water sold to Jewish settlers.

Palestinian farmers have acted to diversify their crops, shifting from bananas to tomatoes for example, in order to compensate for lessening water supplies. Citrus crops are at 25% of their 1967 level, and profits from produce sales have dropped considerably, both as a result of these austerity measures. Furthermore, water needs are not limited to the agricultural sector, as industry too relies heavily upon readily available water resources.

Israeli sources have countered claims of unjust water distribution by stating that Jewish settlers are using water which, until recently, went untapped and that the amount supplied for agriculture for Arab villages is at least twice what it was five years ago. They blame the fact that West Bank Arabs have copied Israeli agricultural techniques since 1967, thereby increasing their water needs. Before 1967, the Israelis suggest, dry farming techniques were utilized by Palestinian farmers.

Israelis also note that the proposed Herodian plan, revealed during the summer of 1987, would have provided more water to West Bank Palestinians than presently exists. Rather than to accept the plan in principle, West Bank residents chose to reject it, for fear that even more water was also to be alotted to Jewish settlements, and to Jerusalem.

The water situation in Gaza is even more desperate than that on the West Bank. The area, 50% of which is desert, has only one aquifer. The level of water salinity is continually rising, and has now reached as high as 800 milligrams per liter. At the present rate, some experts predict that by the year 2000 Gaza's water will be unusable.

To enable Gaza water resources to replenish, the West Bank Data Project estimates that annual water usage would have to be halved to 60 MCM from the present consumption of 120 MCM. No one seems willing to accepts drastic cuts however. Accusatory fingers are pointed in all directions. Partisan politics aside, demographers predict that by the turn of the century, Gaza's population will number 1 million inhabitants. To accomadate these growing needs, water will have to be pumped in from Israel proper.

The only solution to Gaza's water needs appears to be desalinization, but high expense and limited technologies are prohibitive in undertaking such a program. It is estimated that it would take seven years to implement an effective program at a cost of between $40 and 50 million. In the mean time, water consumption continues to rise at an alarming rate. Some observers suggest that a Turkish water pipeline to the region or water shipments from Aswan would prove cheaper and more practical than a massive desalinization project, and would increase agricultural land in Gaza by as much as 75%.

UNDP efforts toward sewage reclamation provides yet another solution to the West Bank/Gaza water crisis. The Israelis have shown some success with reclamation, using reclaimed sewage for industry and urbanization while directing fresh water reserves for agriculture and consumption. Some observers suggest that the Palestinian community does not support reclamation however, and does not believe the plan will sufficiently answer their needs.

Sewage problems in the territories, particularly Gaza, are extreme. In Jabalya refugee camp, for example, open sewage is known to flood low-lying houses, threatening to literally drown small children. One woman was seen to have three feet of sewage covering the floor of her two room shanty.

V. Population Ramifications

The water crises described above stem, in large part, from increased water consumption, which is linked to population growth, expansion of industry and agriculture, and increased urbanization.

In table 1 (page 16), startling statistics on population growth in the countries under study have been provided by the Population Reference Bureau. To help understand the magnitude of the problem congronting countries in the region, table 2 (page 17) details the average annual discharge of the river basins in question.

In examining table 1, note that a natural annual population increase of 1 percent or lower is generally considered "manageable." The United States and other Western nations have rates equal to or well below the 1 percent level. Rates of 1.5 percent and above can have catastrophic consequences for developing nations. In this regard, the countries under study are caught in a population spiral that is out of control. As domestic, agricultural, and industrial demands mount, many countries will confront extreme difficulty in providing sufficient quantities of water to their citizens. Even Israel, with its comparatively modest growth rate of 1.6 percent per annum, will be forced to wrestle with the consequences of a seriously overextended resource infrastructure.

TABLE 1

Population Growth in the Middle East

Country	1986 Population (millions)	Crude Birth Rate*	Natural Increase**	Estimated Population in 2000 (millions)
Lebanon	2.7	29	2.1	3.6
Jordan	3.7	44	3.7	6.4
Israel	4.2	23	1.6	5.3
Syria	10.5	47	3.8	17.2
Iraq	16.0	46	3.3	24.2
Sudan	22.9	46	2.9	34.2
Egypt	50.5	37	2.6	71.2
Turkey	52.4	35	2.5	69.7
U.S.	241.0	16	0.7	268.0
World	4,942.0	27	1.7	6,157.0

Source: World Population Data Sheet (Washington, D.C.: The Population Reference Bureau, Inc., 1986)

* Crude birth rate is the number of births per 1,000 persons.

** Natural increase is the annual percentage increase in population.

TABLE 2

Average Annual Discharge Rates

River	Discharge Rate (million cubic meters)
Jordan*	1.287
Euphrates	31,820.00
Tigris	42,230.00
Nile	92,600.00

Source: Figures compiled by the authors from government sources.

* This statistic was taken from the Johnston Plan.

VI. Recommendations

Outside assistance in facing Middle Eastern environmental issues is essential if crisis conditions are to be alleviated in the future. Cooperation amongst all parties in the region, though the ideal, may not be immediately feasible. Foreign assistance programs may thereby provide the needed impetus to meet future water challenges in the region.

The emerging water crisis and its effect on the region's stability, and ultimately on strategic oil supplies, represents a serious foreign-policy challenge for the United States. Unfortunately, no simple solutions exist. Questions of water management touch on issues of economic growth, social development, intra-regional relations and national pride. Policy-makers are thus confronted with a modern-day Hydra.

The United States can help meet these challenges in numerous ways however:

1) Through both government and private sources, funds can be provided for R&D projects to accelerate the development of technologies. Breakthroughs in energy technology and consequent reductions in energy costs will make advanced water resources technology affordable for all Middle East countries. In particular, Jordanian experts recommend that R&D monies be channeled specifically into the development of technologies for water reuse and desalination. These efforts must be iniatated

immediately, however, given the span of time required to realize gain.

2) Research monies spent domestically on water technologies can be increased and the results shared with the Middle East nations (the U.S. currently spends approximately $20 million on such efforts). Effective management of existing resources is often as important as identifying new sources. Government and industry officials alike agree that improper or inefficient management techniques are common in the Middle East, and improved training programs for technicians and engineers who operate water facilities are essential.

Increased coordination among U.S. government agencies involved with water resources mangement and development is also needed. U.S. officials acknowledge the difficulty in achieving a regular dialogue among responsible agencies, and the effect this may have on U.S. government cooperative efforts with Middle East governments.

3) The scope of existing technical education programs for Middle East experts can be expanded. There is considerable agreement that the United States should widen its technical outreach to regional governments. A U.S.-based water institute should be created to sponsor R&D projects on water technology. These projects could have applications world-wide and would allow engineers and scientists from abroad to participate in state-of-the-art research. The institute could also provide

training and education programs for technicians form the Middle East and other regions.

The institute could also accelerate the development of technologies in such areas as water reuse and desalination. Nonetheless, in should be noted that dependence on desalinization to meet water requirements is neither desireable nor economically feasible; desalination of sea water, for example, is practical only if undertaken on a large-scale basis. Still, sophisticated technologies like desalination will become crucial in alleviating future water shortages in the region.

Israeli civil engineer Avraham Melamed has proposed a major desalinization project which he describes as a "Regional Water Energy Peace Project for the Middle East." Mr. Melamed's plan calls for the transforming of the large sea-water Bardaweel Lagoon, located in the Sinai Desert along the Mediterranean coast, into a solar pond that could generate energy to fuel a large desalinization plant. Since an enormous amount of energy is used in the desalinization process, traditionally only energy-rich countries, such as Saudi Arabia, could afford to undertake this type of project. But by using solar energy, the cost of desalinization would be drastically reduced. The proposed scheme, according to Melamed, could desalinate 600 MCM of water annually, and 20,000 megawatts of surplus electricity could be generated. Water could be piped to Jordan as well. The project could serve not only as a solution to the Middle East water crisis, but as a great incentive for fostering peace in the region. Such plans should be given thoughtful consideration.

4) The United States can assume the role of an active political intermediary where desired, thereby helping to create a stable political environment in the region. This is an issue which elicits wide debate concerning the United States government's role in addressing these challenges. A high-level Turkish official has stated that "help from the industrialized countries--and the United States in particular--will contribute to the peace and stability of the region and foster development." The complicated link between natural water availability and regional needs for water use must be stressed in the years ahead. Attention to such intra-regional tensions could help mitigate the potential for conflict over water the world over, particularly in the Middle East and Africa.

Conclusion

The Soviet Union is presently allocating more than $200 million annually for global water resources investigative research by state-supported global water resource institutes. The United States, by contrast, spends less than $30 million annually--the majority for naval-related issues. Moreover, no U.S. agency has specific responsibility for data collection or analysis on international water resource questions, nor even the most basic computerized data retrieval capability.

There is a vital need to stimulate U.S. government thinking on these matters.

Stress must be placed on the importance of improved cooperation between the U.S. government, European donor nations, Japan, the Middle Eastern states, and potentially the Soviet Union in the sharing of information, as well as the coordination of water development strategies and projects. An initial objective must be to put water on the U.S. foreign policy agenda as the first crucial step in this process. For at this juncture, no country or international agency is providing the necessary leadership in developing a coordinated and comprehensive response to the water emergency.

The issues of global warming and the greenhouse effect must be considered as well, as they too are creating notable effects upon the world's water supply. A recent study by the American Association for the Advancement of Science forecasts a shift in normal supply patterns, with less water flow to arid regions. Salt pollution of coastal aquifers and the flooding of lowland areas are also increasingly likely. Although it is early yet for scientists to predict how quickly or to what degree the warming trend may develop, preventative actions are appropriate immediately. Creating infrastructure to allow the flexible allocation of water, conservation, and improved pollution regulation all serve to prepare ourselves for the worst.

The environmental and developmental issues of our times must be faced and dealt with now, before it is too late to turn back. James Speth, president of the World Resources Institute, has recently stated that societies can both confront the environmental issues of our day, and achieve economic growth. But this is only possible, he suggests, by bringing about a transformation in the technologies of "production and consumption." "Only technology can save us," he suggests. "Science and engineering must have the financial support and the incentives to provide us with an accurate understanding of the Earth's systems and cycles, and the effects of human actions."

Indeed, the water crisis in the Middle East is but the tip of an economic and environmental crisis now overtaking our planet. It is with this attitude of global security and concern in mind that the Middle Eastern governments should cooperatively develop and maintain water technologies in the decade to come. Development issues in the region, specifically those related to water, must be depoliticized. For ultimately, the one challenge which all Middle Eastern adversaries share in common is the race against time to save and manage precious water resources.

Mr. SCHEUER. Thank you very much, Dr. Starr.

All right. Now we will hear from Pat Baldi, who is Director of Population Programs for the National Audubon Society. Ms. Baldi has extensive background in the fields of population, family planning, health and environment. She came to the Audubon Society from the Center for Population and Family Health at Columbia University, and she spent five years with U.S.A.I.D. and has worked in numerous developing countries all over the world. We are very happy to have you appear before this committee once again, Pat Baldi. Please take your five or six minutes and chat with us informally.

STATEMENT OF PATRICIA BALDI, DIRECTOR, POPULATION PROGRAMS, NATIONAL AUDUBON SOCIETY

Ms. BALDI. Thank you, Mr. Chairman, and members of the committee. I actually started my international career as a Peace Corps volunteer in Brazil many, many years ago, far more than I want to talk about, but I have a real interest, strong interest in what you had to say about the tropical forests in Brazil and some of the other issues.

I also am from Texas, as is my colleague, Frances Spivy-Weber—not from the same place—but I can remember the woods north of Houston, in Conroe, where I grew up, which are no longer there. It is part of what we are seeing today in the process of doubling times. We have doubled our population in 37 years, and we have all seen it, and we may double it again, and we may all see it again. Some of us will live that long. It is of grave concern, because not only are there implications in terms of the resources, but it has implications for quality of life for people in the way they want to live. I think that is what wraps the population and environment issue back together.

Human ecologists—I know you heard Dr. Ehrlich last week—have been talking about population growth and its implications for the environment for 20, 30 years, but we are already beginning to feel it for the first time, and water—I am concerned about water resources myself, as I look at the year 2000 and the implications for what our resource needs are going to be.

In particular, though, I would like to just say that in the body of my testimony what I tried to do was to link up the tropical deforestation and the global warming and ozone layer depletion and food production, because I think they are very much intertwined. What we will do in terms of finding new food products will depend on those plants that are in the tropical forests today. What we do in terms of our own use of energy resources is going to have a lot to do with the rapidity at which we reach a global warming stage and depletion of the ozone layer. And I like to tell people in this country we have a population problem in this country as well, in terms of the way we like to live and where we want to live and how we are using our resources.

So it is a small world. It is one world. It is not just the U.S. and Africa and the Middle East any more. If any of you have seen the Bill Moyers' interviews with Joseph Campbell, he talks about a new mythology that Moyers says is space, and he says, no, your picture up here, he says, as you back away out into space, you see no lines between countries and no lines between states. It is just one world. I think that is what we are having to come to terms with.

Now I would just like to say that what is not included in my testimony but I would hope this committee think about at some point is the idea that in the early seventies we had the Rockefeller Commission—you mentioned the Rockefellers—that looked at population growth and tried to project out into the future what was going to happen.

Mr. SCHEUER. I served on that Commission.

Ms. BALDI. Yes, I know that.

I think the time has come when we have a foresight capability, a commission for population, long-range planning, long-range planning that goes all the way down to the local level, local, State, national and international, which can address problems like water or food production or population growth. I think that at the national level, we need to start thinking about maybe a commission on population growth and natural resource use. Now whether that fits in the State Department or the White House or the Council on Environmental Quality, I'm not sure, but I do think that we have less than a decade to make a substantial difference on these problems, and I get very upset when I sit at meetings with scientists and policy planners, and they talk about 20 years or 30 years. If we wait for 20 or 30 years, it is out of our hands. It is in our hands right now. We have a chance to make a difference about population. We have a chance to make a difference about the rate of deforestation. We have a chance to make a difference about a lot of the other issues that we are facing right now. But we have to start now, and we have to do it very quickly and systematically.

My own feeling is that the unfortunate problem is that we have been caught up in a controversy on the population side over the last ten years in particular or longer and that has slowed us down. It certainly has affected women that I have dealt with in the developing world, in terms of their access to planning their families, and to participating in the local economy. I think we have to move beyond that, because we have a much bigger issue out in front of us. So we at Audobon have been working with our network of activists across the country to begin to help them to respond to you or to dialogue with you as Members of Congress about the issues they care about.

The main issues that they care about, if you have seen our report, "A Message to Congress on Sustainable Development in Foreign Assistance" is sustainable agriculture, population growth and energy, environment and natural resources. I think that we have a number of recommendations there which are being presented now to the House Foreign Affairs Committee in response to their rewriting of the Foreign Assistance Act, and we would hope that all the Members would be supportive of that, those particular areas of focus.

That is all I am going to say for right now and hope you will have some questions for me.

[The prepared statement of Ms. Baldi follows.]

What are the Environmental and Political Constraints on Feeding 10 Billion People?

Population, Environment, and Food
Development of Population and Environmental Programs for the 1990s

Patricia Baldi
Director, Population Programs
National Audubon Society

February 28, 1989

Mr. Chairman and members of the Committee, thank you for the opportunity to testify regarding the relationship between population growth, food production, and environment and natural resources. I am Patricia Baldi, Director of Population Programs for the National Audubon Society. The National Audubon Society is a conservation organization of 576,000 members working at international, regional, state and local levels toward establishing an environment which is supportive of a balance between human beings, wildlife and the ecosystem which they share.

As early as the 1950s human ecologists began to warn of the prospects for a Malthusian crash because of rapid global human population growth. Their predictions were viewed as alarming, and many people turned away from the thought of such a nightmare vision of the future. The "population explosion" seemed to be unimportant compared to other social and economic phenomena which were taking place in the world. In fact, economic development and new technology were providing answers to an array of problems. Innovations in medicine were having profound effects on health and longevity of life.

In the past several years a renewed concern for the implications of rapid population growth has reached the public and policy makers. In 1987 demographers placed the global human population at 5 billion people. It did not take one hundred years for the population to double from 2.5 to 5 billion, the world's population doubled in a span of time (thirty-seven years) for many people to remember the changes in their environment and quality of life.

China reached a level of 1 billion people and was faced with the problem of feeding, housing and clothing their citizens. They responded by setting a limit of one child per family. They have been accused of enforcing this family size restriction too vigorously. Bangladesh, with 107 million people, has instituted a two child family and will double its population in 26 years. Kenya with a 4% growth rate and a population of 22 million is expected to double its population in 18 years. The implications of these demographic projections for countries already struggling to promote economic and social development is staggering.

In January of 1989, Dr. Nafis Sadik, Executive Director of the United Nations Population Fund, brought us the latest news. At a press conference marking the Fund's 20th anniversary she stated, "The median projection of population stabilization in 100 years of 10 billion, which everyone believed was going to be the figure, seems to be in some danger of being much higher." In fact the latest projections show that stabilization of population growth could be as low as 8 billion or as high as 14 billion. The difference is whether we are successful now in addressing population issues.

Behind all of these numbers are human lives, many of whom will never have the opportunity to expect the most basic quality of life. Ninety percent of the population growth will take place in the developing world. And the United States is not immune. We are affected by consumption, population density and private and commercial development. As a result our population problems are contributing more than our share to the global environmental issue.

In 1950 there were only two cities with a population over 10 million, New York and Paris. By 1975 that number had grown to seven. By the year 2000 over half of the people in the world will be living in cities and the number of cities over 10 million will be 26. If we add the cities of the world with over 5 million, the number will be 58. The result of this migration and growth in urban areas will be increased pollution, major pressure on sanitation and health services, more crime, more crowding, and diminished human services in general.

There is evidence of the impact that we have on each other that crosses international boundaries. The examples range from acid rain pollution shared by the United States and Canada; erosion by the Ganges river which runs through India, Nepal, Bhutan, and China; and migration across borders in Africa. Global interdependence has reminded us all of our mutual importance to each other. Major global problems like depletion of the ozone layer, the greenhouse effect, loss of biological diversity, soil erosion and desertification are all connected in some way directly or indirectly to ever increasing numbers of people. A better understanding of poverty is refocusing environmental agendas as well.

Inter-connections among the people, land and food equation can be seen best in the issues of tropical forest and biological diversity loss, depletion of the ozone layer and advancing global warming, and the potential for food production. Forest loss is contributing to climate and atmospheric change which will impact on agriculture. Population growth is an underlying factor in all of these interconnections.

Population Growth, Tropical Forests and Biological Diversity

Increased food production is dependent on land, preferably productive land. Agricultural technology attempts to increase effective use of the available land to maximize its productive capacity. Whether the land is exhausted or the number of people to be fed expand beyond the land's capacity, the search for new land begins.

There is uncultivated land on earth. It currently includes small lush tropical forests. These forests cover less than 12 percent of the earth's land surface, and 27 million acres are lost each year. By 1980 more than 40 percent of the tropical forest had been destroyed.

The forests primarily are concentrated in Central and South America: Bolivia, Brazil, Colombia, Costa Rica, Ecuador, Nicaragua, Panama, Peru, and Venezuela; coastal West Africa: Cameroon, Gabon, Ivory Coast, Liberia, and Zaire; and temperate South Asia: India, Indonesia, Malaysia, Papua New Guinea, Philippines, and Thailand. In addition there are tropical forests in Madagascar off the coast of East Africa. All of these countries have high rates of population growth.

A 1982 U.N. analysis of the agriculture carrying capacity (more about this study later) in 117 developing countries concluded that, at the low level of agricultural inputs, by the year 2000 some 64 countries - with 1.1 billion people - would not be able to provide even the minimum level of nutrition. The tropical forests are primarily located in developing countries which are trying to raise their economic status as well as feed their population.

It is clear that with current rates of population growth, pressure will increase in these countries to provide economic opportunities as well as basic human services. In addition, even the most conservative estimates are that forest regeneration will take 50 years. If countries are doubling population in the time indicated in the attached Table 1, it will be extremely difficult to counter this destruction.

Population Growth, Depletion of the Ozone Layer and Global Warming

It is only recently that research on atmospheric changes has been documented; however, the conclusion that the powerfully devastating changes taking place in the global atmoshpere are related to population growth and the accompanying growth of polluting industries is obvious.

In 1985, scientists first detected a hole in the ozone layer over Antartica. More recently it was discovered that from 1979 to 1986, stratospheric ozone thinned by five percent over the entire globe. Depletion of the ozone shield has been attributed to chlorofluorocarbons (CFCs), industrial chemicals used in refrigerants and aerosol propellants. Methane is tied to atmospheric and climate change as well as destruction of the ozone layer.

Scientists have analyzed carbon dioxide and methane in the air trapped in ice laid down centuries ago, which gives them the opportunity to measure historic changes in the atmosphere. Levels of carbon dioxide in the atmosphere rose by nearly 25% from the 1750s until today. Methane levels have been rising in tandem with human population growth as a result of increased cattle, agriculture, coal mining and fossil fuel burning. Comparisons with graphs of rises in population growth, methane level and carbon dioxide level demonstrate parallel J curves since preindustrial times. Findings of the United Nations Environment Programme indicate that future levels of methane in the atmosphere will continue to rise in correlation with human population growth. The lag time in adding the next billion people to the earth gets shorter; and the rate of increase in levels of methane and carbon dioxide is rising.

Of course not all of the changes occuring to climate and ozone layer can be attributed to the numbers of human beings. But almost all the changes can be linked to human activity.

We need to reduce the amount of fossil fuel we use. There are still tremendous gains to be made in energy conservation. Alternative energy sources that do not release carbon dioxide, such as solar, wind and wave power, have not been adequately developed.

We need international conventions to retard deforestation, which contributes to the greenhouse effect. Agroforestry and reforestation should be promoted whenever possible.

Finally, we need to promote a policy of population stabilization, including in the United States. Data for population planning is essential; and access to family planning is critical.

Population Growth, Food and Agriculture: A Carrying Capacity Problem

There are some who believe that scientific and technological advances in agriculture have yielded an era in which harvests are now outpacing population growth, producing more food than the world needs. These same people believe that distribution and inequities in income leave many without sufficient food to eat. Hunger is the result, at times, of political and policy decisions instead of a shortage of food.

The other side of that issue can be documented just as clearly. Although worldwide food production is rising, there appear to be limits to the earth's ability to keep up with rapid population growth. Food distribution is already a major problem within the many developing countries, especially those experiencing droughts. In addition, topsoil loss around the world is reducing the productivity of the land.

It is clear that the drought situation is critical and that farming practices are contributing to the problems of food production. The most obvious human result of famine and drought is hunger and malnutrition. Because of the unproductivity of agriculture efforts in the Third World, farmers become vulnerable to crop failure, drought and natural catastrophe and remain the poorest in their societies.

The efforts to feed the people on their land become monumental. Economic considerations become important especially as one reviews the practices within countries where food is an export. In Africa, the region's rapidly growing population -- it has some of the highest birthrates in the world -- demands increased food production. However, the Sahelian countries have opted to encourage the cultivation of cash crops at the expense of food crops. In some African countries women have called upon tribal leaders to set aside land for them to grow food crops because their husbands were planting cash crops while their families starved.

The previously mentioned United Nations study on agriculture sustaining capacities of countries throughout the world found that by the year 2000 with a global population of 6 billion, the world agricultural output must be 50 to 60 percent greater than in 1980. Because of population growth in developing countries the demand for food and agricultural products will double.

The study assesses countries on the basis of levels of inputs; low, intermediate, and high, of modern technology. Low inputs, for example, would consist of basic subsistence farming. By the year 2000, 64 countries -- more than half the total studied -- would be unable to feed their expected populations from their own land resources with low inputs. Modern technology is being seen as a solution -- another "Green Revolution". For countries already under enormous debt repayment pressures as well as the strains of accommodating the social needs of their populations, modern technology may be too expensive. And on the ecological side modern technology often has contributed to loss of the natural resource base in many countries.

Where Are The Solutions?

At National Audubon Society we believe that part of the solution lies within a reformulation of the Foreign Assistance Act of 1961, as amended. This year the Congress will have the opportunity to reauthorize the legislation and at the same time make it more responsive to the needs we are emphasizing today. With this in mind we are working to bring local citizens into the foreign policy process. Several weeks ago we delivered to each member "A Message to Congress on Sustainable Development in Foreign Assistance". I leave to my colleague, Frances Spivy-Weber, to relate the recommendations on agriculture, energy, environment and natural resources and will confine my testimony to the recommendations on population.

The major task is to **reaffirm the United States commitment to assistance for population policy and family planning.** For a quarter of a century this government has played the significant leadership role in international population and family planning which has led to dramatic results. The most striking result is that in 1965 only 15 countries had policies favoring lower population growth. By 1974 that figure had increased to 31 countries and in 1988 the figure rose to 64 countries. That progress can continue with strong support from the U.S. government.

That support will be marshalled through the following specific actions in a new Foreign Assistance Act.

*Restore funding for multilateral population organizations such as the United Nations Population Fund and the International Planned Parenthood Federation.

*Remove all legislative restrictions which prevent the Agency for International Development from responding to developing country requests for population and family planning assistance.

*Encourage the recruitment of population officers for all high growth countries.

*Maintain and strengthen the technical focus provided by the Office of Population of the Agency for International Development by designating half of all population funds for the central program.

*Improve the efficiency of population assistance through pilot projects, private sector involvement, long-term sustainability, local manufacture of contraceptives and contraceptive research.

*Continue support for data collection and research on the consequences and causes of rapid population growth, focusing activities on operational policies, and building developing country capacity to conduct population programs.

The obvious task is to see that the awareness among countries and donors grows about the interrelatedness of the land, people and natural resources and that programs are designed with these linkages in mind. Although Africa may be the most dramatic case in point as a continent, the desire for the goal of equitable, participatory, environmentally sustainable, and self-reliant economic growth is a global aim. In considering the future we will have to be concerned with consumption inequities between developed and developing countries and trade imbalances as well. It is not simply an issue of growing more food for more people. We also must come to grips with the fact that the actions we take are closely related. People by number or by use of resources are having a powerful impact on the globe.

Table 1

Population Growth in Tropical Forest Ecosystems

	Population Est. 1987	Doubling Time
Africa:		
Cameroon	10.3 million	26 years
Gabon	1.2 million	43 years
Ivory Coast	10.8 million	23 years
Liberia	2.4 million	22 years
Madagascar	10.6 million	25 years
Asia		
India	800.3 million	33 years
Indonesia	174.9 million	33 years
Malaysia	16.1 million	28 years
Papua New Guinea	3.6 million	29 years
Philippines	61.5 million	25 years
Thailand	53.6 million	33 years
Latin America:		
Bolivia	6.5 million	27 years
Brazil	141.5 million	33 years
Colombia	29.9 million	33 years
Costa Rica	2.8 million	25 years
Ecuador	10.0 million	25 years
Nicaragua	3.5 million	20 years
Panama	2.3 million	32 years
Peru	20.7 million	28 years
Venezuela	18.3 million	26 years

Sources: Population Reference Bureau and World Resources Institute

Mr. **Scheuer**. Very good. Thank you very much, Pat Baldi.

I now will move on to Frances Spivy-Weber, who is Director of the International Program at the National Audubon Society. She is Special Assistant for International and Marine Wildlife Programs for the Animal Welfare Institute and the Society for Animal Protective Legislation. She has served many times as a U.S. delegate for environmental issues.

We are happy to have you here, Ms. Spivy-Weber, and we look forward to your testimony, five or six minutes, then we will have some questions for you when we finish the panel.

STATEMENT OF FRANCES SPIVY-WEBER, DIRECTOR, INTERNATIONAL PROGRAM, THE NATIONAL AUDUBON SOCIETY

Ms. **Spivy-Weber**. Okay. Thank you very much. Pat and I have divided our responsibilities on this. She touched mostly on the population issues, and I was going to stress particularly the agricultural and environmental issues.

A lot of people ask why is Audubon, an organization that was set primarily to protect birds, interested in development. One of the things that we have learned over almost a century of existence is that the birds are going to take care of themselves; it is people that are the problem. To carry that a bit farther, we are finding that what is good for the proverbial goose, even the goose that lays the golden egg, is also good for people. People need clean water; people need forests, grasslands, wetlands, estuaries, ocean areas. And these do have strategic importance, all of these, these various environmental factors.

You ask what can we do to get environmentally linked foreign assistance, and I have outlined in my paper briefly some of the things that I think are particularly important, but I would also add that it is not just environmentally linked foreign assistance, it should be culturally linked as well. If you have environmentally and culturally linked foreign assistance, you have got a chance of making a difference.

Now the basic fact of achieving environmentally linked foreign assistance is to make sure that the foreign assistance does not degrade the resource base. That should be fundamental. We should be having a sustainable development policy that should be the focus of our Foreign Assistance Act. In order to have culturally linked foreign assistance and environmentally linked foreign assistance, we are going to have to involve local communities participating in the decision-making process on development. It can't be just top down; it's got to be bottom up as well.

The elements of the environment that are most critical are, as has been stressed earlier, water issues. They are fundamental. If we don't have water, we are not going to survive and to protect the water resources, priority has got to be given to watershed management, water efficiency technology, pricing policies, adequate disposal of industrial wastes and stricter use of phosphates and fertilizers. Again, we are going to have to be working both at the local level as well as at the policy level.

You mentioned Brazil. We are going to have to work on our forestry policies, internationally, but we are also going to have to work on our forestry policies, domestically. Reducing pressures on the forests will require improved agricultural efficiency and innovative ways of working with the forest without destroying it.

For climate change, the big issue there that people are talking about these days, global warming, I think most of the responsibility actually falls in the developed world, and that is something that we, domestically, can do to improve things worldwide. We make up only 21 percent of the world's population, the developed countries, yet we consume 85 percent of the world's energy. And this is one of the biggest culprits in the global warming issue. Certainly, population is also a problem as is destruction of the forests, but energy is a big area, and this is something that you have jurisdiction over that you can do something about.

Mr. SCHEUER. Do you have any suggestions as to what we ought to do?

Ms. SPIVY-WEBER. Certainly an energy plan for this country would be the first step that I would take. In order to get that, you may have to be pushing on some individual programs. Energy efficiency is one program. Putting priorities on research in the area of solar and alternative kinds of energy technology is another area, but just energy efficiency, based on current technologies, could solve a lot of our problems right now while we are doing the longer-term research. But that means auto manufacturers are going to have to produce automobiles that they can produce, but they are going to have to retool some of their equipment and get up to 40 miles a gallon efficiency, that kind of thing.

Mr. SCHEUER. Well, they can do a hell of a lot better than that.

Ms. SPIVY-WEBER. Even at that, we would be far along on meeting our goals.

Mr. SCHEUER. The Japanese, the West Germans, the French and the Swedes all have prototype models working that give between 80 and 100 miles to the gallon, 80 in the city, 100 miles on the road. The reason that the American automobile manufacturers are not entering into that competition and are satisfied to develop cars that are in the 50-to-60-mile range is because they say with gas priced as cheaply as it is, it doesn't pay either them or automobile owners to invest in the extra technology that would get them more mileage out of gas at the absurdly low rates that we charge for gas in this country, around a dollar, compared to countries all over the world, all the Western European democracies, that charge between $2.50 and $3.50 a gallon for gas and virtually all of the difference is made up in taxes. Excuse me. Please proceed.

Ms. SPIVY-WEBER. That brings me to the big point that I want to make and that is that there are several responsibilities that need to be shared on working on these issues.

One is, there are interest group pressures. The automobile industries and others are going to—you know, they have their constituents to look out for, as do we, and the budget is not getting bigger. We are watching it stabilize or even shrink. So we have to deal with those kinds of realities. But our representatives in Congress are going to have to appropriate monies to the priorities that are important. They are going to have to bite that bullet. But we too as representatives, as well as taxpayers, are going to have to be much more vocal to you, as our representatives, about what our priorities are. I think that you are going to start hearing from many, many more people that, in fact, the environment is a priority, that it is something that we want you to take care of with us. We are willing to pay more. We are willing to go through a transition period to a more environmentally sound, not only foreign policy, but domestic policy.

Mr. SCHEUER. Well, I think when you find Time magazine forgetting about "Man of the Year" for 1989 and having an entire issue devoted to the "Planet of the Year," on the environment problems of the planet, you know that the problems of our global environment have come into center stage.

Ms. SPIVY-WEBER. That's right. I think the other thing that is very important for us to realize is that we are not in this alone. As you mentioned, there is Japan. Japan is putting a lot of money into development around the world. The Europeans are forming the EC, and they are going to be a very powerful force, both in terms of development as well as economic importance. The Canadians and others are partners in this. There are also—you mentioned the Rockefellers. There are a lot of research institutions. There is the World Bank. There is the UN. We have got partners that we have got to share the load with. We cannot think that we are going to do it ourselves. I think we should be leaders, but we should also be leaders in bringing people together, bringing institutions together to divide up the workload; there is too much for just one group to do, and then we must start getting to work rather than just debating.

Mr. SCHEUER. I was asked last summer to come to Strasbourg, which is the headquarters of the European Parliament, to talk to them about the global environment. And I did. I said, why don't we all get together and form a parliamentary organization that would be thinking about the global environment issues? So they have gotten together, and they have invited me to come over in March to actually set up a parliamentary organization on the global environment. So we are moving by inches, perhaps too slowly, but we are going in the right direction.

Ms. SPIVY-WEBER. I hope that we will be able to help you move along a little bit more quickly, and that is the goal of our Foreign Assistance Action Project. I have brought with me several copies of this, which I will leave for each of you. This does address the Foreign Assistance Act. Specifically, it has recommendations in it as to what we think should be changed in the Foreign Assistance Act to make it more ecologically sustainable. Thank you.

Mr. SCHEUER. You have those recommendations in this report?

Ms. SPIVY-WEBER. Yes.

Mr. SCHEUER. Very good.

[The prepared statement of Ms. Spivy-Weber follows.]

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NATIONAL CAPITAL OFFICE 801 PENNSYLVANIA AVENUE, S.E. WASHINGTON, D.C. 20003 (202) 547-9009

What are the environmental and political constraints on feeding 10 billion people?

Development of Environmentally Linked Foreign Assistance

Frances Spivy-Weber
Director, International Program

28 February, 1989

Thank you for this opportunity to address, on behalf of the over half million members of the National Audubon Society, a stark and fundamental question: What are the environmental and political constraints on feeding 10 billion people? Pat has addressed the population issues associated with development of environmentally linked foreign assistance, and I will focus on the environmental and agricultural development issues.

The question is often asked, "Why is Audubon, an organization founded to protect birds, interested in development?" Our answer is, "We have learned that birds will take care of themselves, if their options for habitat in which to feed and reproduce are not overcome by human competitors." We have also learned that what's good for the proverbial "goose" is also good for people--wetlands, grasslands, forests, clean rivers, estuaries, and oceans. These areas are important to agricultural production, clean water, energy production, and development, and thus ultimately to economic, political and social stability and our own national security.

Environmentally and culturally linked foreign assistance is foreign assistance that has a chance of working. Current global trends indicate a deterioration of agricultural lands and water supplies, loss of biodiversity, loss of natural resources and climate change. Some of this has been caused directly or indirectly, as Pat pointed out, by population growth or population consumption and some by poor past development assistance and the example developed countries have set on tradeoffs for growth and economic development.

In addition to population policies and family planning programs, development assistance must focus on projects that do not contribute to losses in the resource base. Through simple management procedures using minimum inputs, farmers, in many cases, can prevent loss in soil fertility and maintain and even increase productivity. These farming practices must be backed up at the government level through policies that encourage such practices.

Recycled Paper

Creating avenues for local communities to participate in the decision processes of development projects, promoting the use of appropriate technology in these projects, and integrating small farm projects into ones that promote cash cropping are three major components that need to be included in foreign policy that promotes sustainable development--development that leads to food production to feed 10 billion people.

Fresh water and sun are the most important ingredients for supporting life on earth. Yet demands for food and energy threaten water quality and quantity. To protect this renewable resource, priority must be given to watershed management, water efficient technologies, pricing that reflects the real costs of supply, adequate treatment of industrial waste, and stricter regulation of the uses of phosphate and fertilizers in agriculture.

Reducing pressures on forests will require improved agricultural efficiency, innovative ways to use the forest for fuel, food, and shelter, and public education on the importance of the forest.

Agriculture, fisheries and coastal developments will all feel the impact of predicted changes in climate. While some climate change is inevitable, efforts to control atmospheric emission, including energy conservation, recycling and reduction of forest loss are needed to dampen the extent of this predicted disaster. Developed countries make up only 21 percent of the world's population yet consume 85 percent of the world's energy. Therefore it is the developed world that has a critical role to play, as conserver of energy at home and contributor to conservation abroad as we build a sustainable future.

Another point in averting or treating environmental distruction is making conservation an important part of development planner thinking. In some cases, as with tropical forests and biodiversity, we are running out of time. We are losing 3000 acreas of tropical forest per hour with zero chance of ever realizing the potential of the unique plant and animal species extinguished in the process.

The challenge is a serious one, but practical questions must be addressed. Our foreign assistance program will have to recognize current budget constraints and interest group pressures. Congress must be willing to authorize and appropriate sufficient sums of money to meet clear targets of expertise where the U.S. has a comparative advantage. Taxpayers must speak out as never before that they want the environment to play a central role in foreign policy.

The National Audubon Society has proposed a new foreign assistance program that puts ecologically sustainable development as the area of focus. Our members across the country are beginning to talk to their community leaders about ecologically sustainable development. They are spreading the word that foreign assistance must focus on population, sustainable agriculture and energy, environment and natural resource programs. They are calling on the U.S. to divide the work with other donor countries, multilateral institutions, and private donor foundations to maximize the use of expertise. The U.S. clearly has high levels of demonstrated expertise in population and family planning and vast experience in natural resources and environment. Because of the U.S. expertise in agriculture and the importance of U.S. surplus commodities to developing countries, we should continue to support an agriculture program, but only if it is planned and implemented in an ecologically sound manner.

Partnerships with experts in developing countries are important to a restructure of our foreign assistance program, as are programs with low and middle income countries which are affected by the triad of rapid population growth, environmental degradation and the need for sustainable agriculture.

Specific recommendations for the new Foreign Assistance Act focus on ecologically sustainable programs in Agriculture; Energy, Environment and Natural Resources include:

1. Establish an agriculture development program concentrating on a) working directly with farmers, b) sustainable agriculture, with an emphasis on small-scale agriculture, c) policy dialogue.

2. Adapt systems of technology transfer to local conditions.

3. Focus the policy dialogue at the macro-economic level and give particular attention to the benefits and risks of biotechnology.

4. Establish a new Energy, Environment and Natural Resources program that a) meets energy needs in ways that are ecologically sustainable, with an emphasis on energy assistance to meet human needs while minimizing global warming, b) conserves tropical ecosystems and biodiversity, c) encourages effective regulation and control of pesticides, with particular attention to protection of groundwater and drinking water supplies.

5. Transfer a minimum of $600 million from military assistance to bilateral development assistance in agriculture, energy, environment and natural resources, and population.

Last year the World Commission on Environment and Development released its three-year study, which found that most of the heavier effects of acid precipitation, global warming, ozone layer depletion, or widespread desertification and species loss will not be felt in the lifetime of today's decision-makers. The young voters and the children of today, however, will inherit these problems. The report concludes that in order to make economic development a long term sustainable objective, environmental and population issues need to be an integral part of development programs.

The National Audubon Society is committed to work with its members and through them, with citizens in communities across the country to mobilize political will for meeting the challenge of achieving an ecologically sustainable future.

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Mr. SCHEUER. Okay. Now we are going to hear from Ms. Ofosu-Amaah, who will talk to us about women's issues and the African Women's Assembly on Sustainable Development. Ms. Amaah is a founding member of WorldWIDE, a nonprofit women's environmental organization, and she spent many years at the International Institute for Environment and Development. She has a law degree from London University and an M.A. from the University of Maryland.

We are delighted to have you here, Ms. Ofosu Amaah. Please take your five or six or seven minutes, and then we will have some questions for you.

STATEMENT OF WAAFUS OFOSU-AMAAH, FOUNDING MEMBER OF WORLDWIDE.

Ms. OFOSU-AMAAH. Two weeks ago I attended this African Women's Assembly in Harare, Zimbabwe. It was organized by the UN Environment Program with sponsorship from various international organizations, and the theme was "Food and Energy Self-Sufficiency in Africa." About 20 countries participated. Most of the participants were African women farmers, educators, people from all walks of life, but people who had a lot of experience working on the land.

The three issues which you mentioned of energy, sustainable agriculture and environmentally sound development were very much in the forefront of those discussions.

What I am going to talk about are the problems which these women, the African women, saw as far as their participation in ensuring food and energy self-sufficiency in Africa was concerned.

Women dominate food and agricultural production in most parts of Africa. Actually, in some parts they provide between 60 to 90 percent of the self-sufficient agricultural labor and also a substantial portion of the agricultural labor on large-scale commercial schemes. Also due to the large rate of urbanization in many parts of the world, many parts of Africa, women are the heads of households. They have to run households as well as take care of agricultural production.

They felt that despite this important role which they play, they were being ignored or neglected by policymakers, by decisionmakers. And I think the relevance of this assembly in the discussions for this particular committee is, as Frances Spivy-Weber pointed out, the importance of culturally-linked foreign assistance. These women felt that there was some cultural constraints on their participation in effective development programs. They were not consulted, and that was one of the reasons why many of the so-called "development programs," especially foreign assistance programs, have not been successful. They were treated merely as implementors, and their needs, their concerns, their knowledge was often not even incorporated into any of these development, planning and implementation activities.

Certainly, there are many socioeconomic factors which limit their effective participation, and they were very keen on bringing these out and discussing them.

One was the limited access to land title. Many felt that this severely limited their ability to participate effectively in the economy, because they did not have access to capital. They did not have money to buy some of the tools necessary for effective agricultural production. Some pointed out, though, that the fact that one did not have access to legal title to land, should not affect the need to husband land resources effectively, but still, it was important to realize that such lack of access severely put a constraint on the ability to develop further in terms of gaining access to credit and to capital.

They also talked about their heavy workload and the burdensome demands on their time for food production, food preservation, agriculture, child rearing. They really are the natural resource managers in Africa. Actually, the average workload they claimed, and it is true, is much heavier than men's.

Another constraint was the high illiteracy rate among women and that has been touched upon. They felt that education programs should be designed so that they, these women, would become the true beneficiaries of that program.

A fourth constraint was their limited access to credit, and that is related to their limited access to land.

Finally, their limited access to tools and technologies necessary for successful agricultural projects. They pointed out, for example, that water—potable water supply projects often relied on hand pumps, most of which were so heavy that it was obvious the designers were not aware of the fact that in many parts of Africa, it is women and children, particularly young girls, who are responsible for supplying and meeting the water needs of their families. That comes back again to culturally linked foreign assistance programs.

They gave some examples of successful projects, local level projects which have improved women's lives, mainly involving cooperatives, all-women cooperatives for small- scale farming, because most of the agricultural activities relate to subsistence farming, and that comes back to the strategic issue of food self-sufficiency, because these large-scale projects, they insisted, were really for cash crops and not to provide food, provide a need, a food need of the local communities.

Mr. SCHEUER. You are speaking of cash crops for export.

Ms. OFOSU-AMAAH. For export, yes.

The Assembly broke up into committees to discuss specific topics such as seas and rivers and basins, deserts and arid lands and seas. One common theme was that there were often conflicting goals, and these goals had to be realized for specific policies to be responsive to these conflicting goals. One, for example, was livestock raising. In many parts of Southern Africa—the participants from Botswana, Lesotho, for example, pointed to the fact that large-scale livestock raising was necessary for foreign exchange generation, and yet imposed a severe strain on the land.

That came back to the question of population, both animal and human population. This came up in all the discussions, and it led—even though there was no detailed discussion about what exactly to do about the population problem, there was a great deal of support for family planning and family control policies. Women—all of the women or most of the women said, "we are all for it". The main constraint really comes from their male counterparts.

One of the major recommendations that came out of the assembly was the need to link population control with environmental and natural resources management, make that an integral part of the solution, and specifically for governments, donor agencies, and aid agencies, to organize and to strengthen education programs on the beneficial aspects of population control, specifically targeted at men, so that men would become sensitized to the need for population control policies.

The rest of the discussions are highlighted in my testimony which is part of the record. Thank you.

[The prepared statement of Waafus Ofosu-Amaah follows.]

HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY

SUB-COMMITTEE ON NATURAL RESOURCES, AGRICULTURAL RESEARCH AND THE ENVIRONMENT

HEARINGS ON THE FOOD-POPULATION EQUATION

FEBRUARY 28, 1989

TESTIMONY OF WAAFAS OFOSU-AMAAH
WORLDWIDE
1250 24th Street, N.W.
Washington, D.C. 20037

REPORT ON THE AFRICAN WOMEN'S ASSEMBLY
HARARE, FEBRUARY 5 - 9, 1989

My name is Waafas Ofosu-Amaah and I am testifying on behalf of WorldWIDE (World Women in the Environment), an international non-governmental organization created in 1981 to mobilize and enhance the capacity of women to participate in the protection and management of ecological systems and natural resources.

WorldWIDE's goals are: (a) to establish a worldwide network of women concerned about environmental management and protection; (b) to educate the public and policy makers about the vital links between women, natural resources and sustainable development; (c) ensure that women and their perceptions relating to the environment and natural resources are incorporated into the design and implementation of policies and programs; and (d) to support and enhance the capacities of women, individually and in organizations, to engage in environmental and natural resource projects.

Two weeks ago, I represented WorldWIDE at the First African Women's Assembly on Sustainable Development in Harare, Zimbabwe. My testimony presents a report on this Assembly and on some of the issues of relevance and interest to this Sub-Committee which were discussed at this Assembly. The agricultural activities many of these women are involved with or concerned about relate to subsistence level activities. Most participants spoke about problems faced in producing agricultural products for their families, and not as cash crops.

The Assembly

The Assembly was convened by UNEP's Senior Women's Advisory Group as a forum for the discussion of sustainable development in Africa. A special theme of this gathering was the role of women in ensuring food and energy self-sufficiency on the African continent. Participants included farmers, educators, community health workers, development planners, foresters, economists and grassroots workers from the following African Countries: Botswana, Cameroun, Central African Republic, Chad, Congo, Egypt, Ethiopia, Ghana, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Swaziland, Tanzania, Tunisia, Zambia and Zimbabwe. Bilateral aid agencies, U.N. organizations, and international N.G.O.s also participated.

The Problem

Women dominate agricultural and food production in Africa. Women play a predominant role in natural resource management, yet their needs, concerns, experience and expertise are often ignored by government sponsored programs. The African woman's traditional role is that of a natural resource manager because she spends a good part of her day in agroforestry, animal husbandry, water supply and energy management. Her daily chores include soil preparation, sowing, planting, weeding and harvesting, (both for cash crops and for subsistence farming), food processing, preservation and marketing, livestock rearing and the production of dairy products.

In some parts of Africa, women provide between 60 to 90 percent of the subsistence agricultural labor. They also constitute a substantial portion of the paid agricultural labor in male-run commercial agricultural schemes.

Due to high rates of urbanization in Africa, many rural areas are now populated by a majority of females and children. The incidence of female-headed households has increased dramatically (averaging about 22 percent in sub-saharan Africa, and as high as 35 percent in Zambia). These changing socio-cultural conditions in Africa, coupled with the vital role of women in meeting the food and energy needs of a large section of the local population make it imperative for policy and decision makers to incorporate women into development policy making and implementation to ensure that their experience and needs are taken in account. of.

Socio-Economic Factors Affecting Women's Effective Participation.

Assembly participants discussed or heard from experts about the following socio-economic factors affecting women's effective participation in natural resource management programs.

- Women's limited access to land title, long valued in Africa as the a vital determinant of income, especially in rural areas. The limited access severely limits women's access to capital. Some women expressed the view that legal title does not necessarily lead to the adoption of sound environmental and agricultural practices, nor should the lack of such access diminish one's concern for, and commitment for, such sound practices. The important aspect of this particular handicap was its impact on their ability to effectively participate from an economic perspective, such as obtaining access to capital and credit.

• Women's average workload demands are almost onerous, and often heavier than men's. Burdened with the responsibility for household food security and safe water supply, a woman's daily work schedule involves often competing demands on her time. Agriculture and food production, food preparation and preservation, household energy and water supply, child care, in addition to the pursuit of income-generating activities, both within and outside the home are among most women's daily schedules. Without adequate support systems to ease up traditional workloads, women's will not be able to participate more effectively in organized agricultural and natural resources management programs.

• High illiteracy rates among women, mainly because of parents' and cultural biases in favor of male education. This bias was all so poignant at the Assembly during the Zimbabwe National Environment Day awards ceremony on the last day of the Conference. These awards are made to high school students who have made exemplary contributions to a natural resources project, e.g. farming, gardening etc. There was not a single female among the 13 awardees, despite the fact that young female farmers and helpers on the land outnumber their male counterparts. This prompted one participant to say that our thanks and appreciation should be expressed to the female siblings of these awardees (for staying at home to actually carry out the environmental activities for which these boys were being honored) and their mothers (for teaching them the importance and value of environmental conservation activities).

• Women's limited access to credit, despite the fact that they have very high repayment rates. This handicap is partly a result of the limited access to land, often the ultimate security that creditors accept for their loans. Some government programs, for example making it easy for women to qualify for agriculture-related loans are now in place, but more are needed.

• Women's limited access to technology and tools necessary for successful agroforestry programs. Tractors, and other farm equipment often go to women. In mechanized farming, new technologies take over some of the work traditionally performed by women, thereby diminishing women's role in the production process. This diminished role ultimately detracts from women's ability to take part in decision making. Because few women own or manage these large scale mechanized farming projects, they often do not receive the benefits of agricultural extension programs. And paradoxically, some of these advanced projects (which go mainly to men), e.g. irrigated agriculture programs, end up creating more work for women and children, because they have to operate irrigation pumps, for example. One women observed that most potable water projects relied on hand pumps. The designers of such pumps or such projects were obviously unaware of the fact that in many parts of Africa, water supply was handled by women and children (usually girls), neither of whom could maneuver such heavy equipment with except with extreme difficulty.

Successful Local Level Initiatives

Prior to adjourning to small workshops to discuss specific topics, the Assembly heard about some successful local level initiatives involving women as key players in all-female cooperatives.

In Ghana's Dawa village project women farmers are running their own vegetable farm on land specifically set aside for them by their community. This project is now entering its second phase, with women being taught to interplant on this land fast growing economic trees e.g. acacia, to help with soil fertility and to provide woodfuel. They hope to harvest some of these fast growing trees in two years for fuel. Another component of this project involves the drilling of bore holes and the provision of hand pumps for drinking water, and the preservation and storage of their agricultural products. According to the farmer who represented Ghana at this Assembly, one of the beneficial effects of this project has been the self-help spirit in her community.

Zambia's Luangwa rural integrated development project was also described. Although rich in natural resources, this area is a hunger-stricken area because of tse-tse infestation. Its proximity to natural parks made agriculture production difficult. Many of the households are headed by women, because the men have migrated to urban areas to seek employment or to work in the valley in tourist industry. In fact this is a classic example of the policy makers being forced to design an agricultural project specifically for women due to circumstances which they could no longer ignore.. This project is focussing on three main activities:

> Crop and vegetable production, using a new variety of seeds and hybrid maize, and backed by a credit scheme which makes it easier for women to qualify for loans. 289 women had their loans approved in the 1988/1989 season
>
> Poultry production, using a hardy breed imported from Malawi. This project has gone a long way towards meeting the local population's nutritional needs, and the women's need for additional income - they can sell eggs produced in the venture.
>
> Education and training programs, relying on mobile courses to create and heighten awareness about new food production practices now in place.

These activities have been successful, and the next phase of the project will focus on water supply and crop storage schemes. The women have also decided to experiment with the rearing of guinea fowl, another hardy breed which is less expensive to rear because this breed might survive on a less expensive feed.

Workshop Discussions

After these presentations, the Assembly broke up into four working groups to discuss:

1. Rivers and Lake Basins;

2. Forests and Woodlands;

3. Deserts and Arid Lands

4. Seas.

Participants noted that even under the most extreme natural conditions, the ecosystem is capable of achieving a certain stable balance. However, it was largely due to increased human influence and interference, and extreme pressure placed on scarce resources by the animal and human population that land degradation has resulted. The topic of population control was touched upon a few times, but was not discussed in any detail, although there was such strong support for making population control programs an integral part of the solution that the Assembly recommendations relating to population control.

Comments made by participants highlighted the fact that many women were aware of often conflicting goals. The challenge of how to follow practices which would lead to food and energy self-sufficiency, enable women to pursue income-generating activities which at the same time protected an increasingly fragile resource base was very evident throughout the discussions. Three topics relevant to this Sub-Committee's work were discussed.

1. Compatibility between food production and meeting energy needs

Participants touched briefly on the clearing of forests and woodlands to meet fuel needs, to accommodate urban growth and to clear land for agricultural production. There was general consensus that, to a large extent government-sponsored programs have not been very successful for a variety of reasons, among which are:

- Lack of collaboration and integration of local populations, especially women into the decision making for agroforestry programs, e.g. the selection of seeds and types of species to plant.

- Introduction of species (whether indigenous or foreign) which were not compatible with local crops nor acceptable by local communities. In Mali, for example, there are certain taboos relating to Neem trees, (thought by local women to hinder the growth of certain crops) yet these are the species of choice in government programs. Many women expressed dissatisfaction with government-run programs which concentrate on fast-growing but exotic species, such as gum trees. They noted the multi-purpose nature of some indigenous species. Women preferred these species for their medicinal, herbal, pest control and other benefits, in addition to their fuel content. These cultural factors hindered the acceptance of government-run programs because women felt their need were not taken into account.

- Lack of communication between government agencies, (e.g. agriculture, forestry and various divisions within the same Ministry) involved in the implementation of programs.

- Lack of follow-up to reforestation programs in the form of training and advice to the proposed beneficiaries of such programs, mainly women.

- Lack of access to resources, such as seeds, seedlings and common land for village woodlots. Because most programs are centrally-run, with a high level of central government involvement, nurseries are often situated far from villages.

2. Livestock rearing

Overgrazing in many areas due to large livestock populations was referred to at the workshops on arid lands and forests. Participants, especially those from the cattle producing southern African countries noted that in many countries the very process of economic development placed a high economic value on the large scale commercial cattle and other livestock programs for foreign exchange generation. Subsistence level livestock rearing activities also often imposed severe strains on the land, particularly where goats are allowed to graze uncontrolled. Both activities need to be effectively controlled.

However, many women pointed to the dilemma created by the goat rearing problem because goats are often high-income generators for these women. One participant noted that if one were to carry out a study of the socio-economic impact of this type of livestock rearing activity one would see how vital these livestock are to women. Often, the fastest way for a woman to raise money is to rear and sell a goat upon maturity. It was certainly a faster and less expensive option than cattle rearing. Therefore programs to control these activities should focus on paddocking schemes, rather than outright bans on such activities.

3. Stream bank cultivation

Some participants pointed out that stream bank cultivation of vegetables along stream banks, was common, often leading to siltation. Women farmers explained that they engaged in such practices because they did not have the facilities to reduce the drudgery of carrying water from the rivers to their gardens. It was much easier to water a garden along the stream bank than to carry water long distances to the farm, especially when the demands on one's time are so pressing.

Recommendations for Increasing Women's Involvement

The Assembly adopted some recommendations, addressed to UNEP's Senior Women's Advisory Group to deal with some of the issues that were raised and discussed. These recommendations called for:

1.Training of all the players in sustainable development, especially women and grassroots workers, on such concepts as the carrying capacity of the land. Community involvement and participation should be made part of all environmental training and education at all levels.

2. Persuasion of farmers to adopt sound agricultural practices such as the location of crop and vegetable farms at least 30 meters from stream banks to avoid erosion and siltation

3. Seeking the early involvement of women in agricultural and natural resources management projects to ensure that their concerns and insights are incorporated into the planning and implementation of programs. For example, reforestation and other programs to provide vegetative cover should heed to women's needs and emphasize the planting of indigenous plants.

4. Assistance with improved livestock raising practices, especially paddocking.

5. Placing appropriate emphasis on traditional fishing practices, vis a vis large scale commercial fishing. Traditional fishing is an important means of achieving food self-sufficiency for coastal and island populations.

6. Extending the benefits of agricultural extension services to women farmers. Locals and villagers should be trained and employed as extension workers so that they can educate their own local communities.

7. Decentralization of government-sponsored programs to ensure that local level needs are incorporated into project design and implementation. Village nurseries and seed banks in particular should be encouraged.

8. Integration of population control policies into natural resource management policies and programs

9. Increased educational programs particularly designed for, and targeted at men, on the adverse impacts of large families on the natural resource base and on the beneficial impacts of family planning programs.

Mr. **Scheuer**. Very good. Thank you very much.

Ms. Ofosu-Amaah, what can be done to increase food self-sufficiency in developing countries which have severely limited resources for large-scale equipment, for irrigation, for pesticides, insecticides, chemical fertilizers,and so forth? What can be done in a realistic way to help the small-scale farmer in the developing world to be more productive and perhaps assist them in some way making very modest investments in sustainable agriculture?

Ms. **Ofosu-Amaah**. Many women talked about small-scale projects, more little things which have a big impact on their lives. Seeds, for example, the production of—provision of seeds for small-scale farms. They said many programs were heavily centralized, where the seed bank, for example, was in the main city and many of them did not have access to it, to seeds, or would have to travel long distances to get access to. So the localization of many of these agricultural and forestry programs was thought to be very, very important, or even establishing village-level nurseries, so that the women and the children themselves would have a village nursery located maybe in an area which would be easily accessible to a group of five, six villages. That would make a big impact on their lives.

But they kept stressing small scale projects, projects which would help them with a small farm near their house to meet their immediate needs. They also talked about poultry, poultry-rearing activities to help with meeting their nutritional needs.

Mr. **Scheuer**. Ms. Ofosu-Amaah, I am under the general impression that U.S.A.I.D. projects have generally not placed very much of an emphasis on women as decisionmakers in local development nor as women as educators in African society who have the major impact on their kids nor as women as the engine of about 80 percent, maybe 85 percent of all the food raising that goes on, yet, as you know, women play critical roles in all three of these areas.

How do the women that you spoke to at the Harare conference, for example, react to what—do they perceive of U.S.A.I.D. as not really focusing in on the critically important role that women play in education, in food raising, in development? Are they aware of this? Do they react to it?

Ms. **Ofosu-Amaah**. They did not react specifically to U.S.A.I.D, but they reacted specifically to aid donor activities, and they didn't point fingers at donor activities, which include U.S.A.I.D. and also their governments. They said, "we work on the land; we are the main providers of energy; we are the agricultural workers in our countries and yet we are not in your sight". They realize the important role they play is completely ignored by development decisionmakers, and they felt that education was one way to deal with—once they got a certain level of education and were brought into the decisionmaking program, because these programs were designed from the bottom up at the village level, they would be able to play a more critical role.

They also made a recommendation for such training to lead to their employment as extension workers, because most of the time the benefits of extension workers went directly to large-scale farms which are run by men, and they did not get any benefits from that, and they felt with education, with training—and they said, it does not have to be formal classroom activities but just constant instruction with extension workers making sure they get access to people who have a little bit more knowledge they have. Working from there, incrementally, they would get to the point where they can then take over, you know, have enough confidence and take over and start designing, building their own programs.

What was interesting was, there were two farmers who—one from Ghana and one fro—

Mr. **Scheuer.** Farmers?

Ms. **Ofosu-Amaah.** Farmers, women farmers, who were working with cooperatives, who came to present testimony on the programs they had been involved in, and what they pointed out was, with a little bit of responsibility and opportunity they were given to actively participate in designing the projects, deciding what crops to grow, for example, they felt they were contributing so much to their communities, and many people accepted or realized the importance of such local level initiatives in bringing about food and energy self-sufficiency.

Another issue was in relation to reforestation programs. Many women felt that the foresters would come to their village and talk to them about tree planting programs, many using fast-growing but exotic species, especially gum trees, which they were not used to, and that if they are allowed at least to help to take part in deciding which trees to plant in these reforestation programs, because their selection of trees to plant is not random. They plant some of those trees for their medicinal value, for their herbal value, for their pest control value.

There are a variety of multiple reasons why they selected or wanted to plant certain trees rather than the fast-growing ones which the foresters imposed on them. So they felt that there may be a need for compromises because, really, to keep up, to catch up with the damage that has already been done, women need to plant fast-growing trees, whereas, what they want to plant are not fast-growing, but at least they could work together and come to some kind of compromise to meet these conflicting needs.

Mr. **Scheuer.** Well, I understand that they have done a lot of research developing fast-growing trees, both for lumber and for fuel, for firewood.

Ms. **Ofosu-Amaah.** Yes. Southern Africa, Botswana, Lesotho, are working on that. Some participants mentioned these, but these are programs which the women felt they needed to get more information about, they needed to get to them in their own local communities.

Mr. **Scheuer.** Yes. Now Lisa Jordan, my hardworking staff assistant, who works so hard on these hearings, has a question or two to ask you, Ms. Ofusu-Amaah.

Ms. **Ofosu-Amaah.** Okay.

Ms. **Jordan.** Can you tell me if the type of projects, small projects that you are talking about, if the development of more efficient ovens for fuel would be one of those type of projects?

Ms. **Ofosu-Amaah.** Yes.

Ms. **Jordan.** And if so, how could we implement a project like that? Would we have women setting up small cooperative factories to develop those and then have them also distribute them to the marketplace, or where would the role of the women fit in?

Ms. OFOSU-AMAAH. It all depends on the type of energy efficient stove, but one example that came up was a type of stove which used pottery, local pottery. The women mentioned that initially the program was designed from a major regional center, and yet the women who knew how to design these stoves properly were the village women who knew which soils were suitable for the pottery needed for these stoves, and the result was that the first few products were not that successful. Eventually, they had to come back to the village and work with the women who selected suitable soils and designed the stoves.

They talk about the fact that some projects would come to the villages or the towns and supply them with stoves but did not follow up on training on exactly how to use them or how to really realize the benefits they were supposed to gain. So again, it means working, going to the village level, finding out what the needs are and then working with the local people to design particular stoves.

Mr. SCHEUER. Do you have any other questions for the witnesses?

Ms. JORDAN. No. That is fine. Thank you.

Mr. SCHEUER. Oh, no, no, no. We're not finished. My staff members are finished; I'm not finished.

I would like to direct one question to Ms. Spivy-Weber and Ms. Baldi together. We have all kinds of U.S.A.I.D. agricultural programs to assist the developing world farmers in food raising. Did they sufficiently stress the concept of sustainable food production and, if not, why not? And what can we do to encourage them to do that? Is it a question of knowledge? I am going to ask Charles Benbrook, who is on our next panel, and who is one of the nation's great agricultural research experts, whether we need more research to either develop seeds or crops or whatever, that can be grown in a more environmentally sustainable way, perhaps don't have to rely on pesticides, insecticides, chemical fertilizers, and so forth, and I am sure he will give us a very thoughtful answer on what the research needs are. But from the point of view of applying knowledge that we already have, is U.S.A.I.D. up to the mark?

Ms. BALDI. I am going to start and let Fran finish, because she is on an agriculture committee, and I want to give you just my perspective from having been in U.S.A.I.D. I think in the past, if you look historically, everyone was very frightened looking at India and China over the past decade in particular or longer, and we came up with these wonderful miracle crops that produced the Green Revolution and really, in essence, solved the problem or we thought, solved the problem.

From my perspective, at least, there was a point in time when the U.S. university community had the opportunity to do a lot of really exciting research in looking at high-yield crops, and so our tendency was—and it is not just agriculture, it is a lot of other technical areas—was to push our technology off onto other countries as being the solution to the problem rather than getting them involved in creating a solution of their own. I think that probably you will find, certainly in Lester Brown's literature and others, that what we promoted was not only ecologically unsound technology but very expensive technology for developing countries.

I think that is changing, and I think Frances can respond to the changes that are going on.

Ms. Spivy-Weber. Certainly, if you look at U.S.A.I.D.'s appropriations for agriculture, I cannot truthfully say that they are spending even most of their budget on sustainable development projects; however, there has been a change in the last couple of years, in literally two years, there's been a beginning, a glimmer of hope. A committee has been formed in the BIFAD section that works with universities, local universities, to look at sustainable development as a concept and how best to integrate sustainable development into the BIFAD program, which is a big part of the A.I.D. agriculture program, and that has received very enthusiastic support from the universities, which I think is a good first step to making some of the changes in A.I.D.'s program, because, in fact, A.I.D. doesn't do all of its own work. It contracts out a lot of that work to the university system. So we can't just talk to A.I.D. We have really got to work with some of the universities on sustainable development principles.

Another glimmer of hope is in the Africa Bureau they have formed a Natural Resources Section. Again, it is very small within the agriculture program, but it is there, and they have identified it as promoting sustainable development, and it has the support of the Africa Bureau hierarchy.

I think these are small examples of changes that are taking place. Your influence and the influence of other Members of Congress to continue along this track at an even faster rate will help. They do seem to be catching on to what it means when we talk about sustainable development, but I can't truthfully say that they are there yet.

Ms. Baldi. Let me just say one other thing. Last night I was going through the Congressional presentation that A.I.D. has for FY 1990, and I was looking specifically at Africa, and in looking at the Kenya program, you talk about the fastest population growth rate in Kenya, there is not one natural resource project in the Kenya portfolio, and there is a major project on fertilizers. Now it doesn't say ecologically sound fertilizers either, and so I have a big question mark in my mind about what is really happening with the Kenya program.

Mr. Scheuer. That is very interesting. Maybe we will write U.S.A.I.D. a letter and ask them about that seeming imbalance.

I have a question for the four of you and also that I will ask Lester Brown and Charles Benbrook later and Maurice Strong, who will be appearing here.

Is the pressure of Third World debt repayment on those countries—is this inexorable pressure that they are getting from Western bankers to repay their debt, pressuring them to engage in unsound practices of land distributions, unsound practices of concentrating on cash crops for exports rather than production subsistence crops? Is it pressuring them to engage in unsustainable agricultural practices that, in effect, result in their depleting their resource base? How do you see the pressure of Third World debt repayment as influencing these governments to engage in all kinds of unsound and unwise policies and programs?

I don't mean to put words in your mouth. If I am being a little bit too much of an alarmist, tell me so. I would like to be reassured that the situation is not as bad as I think it is.

I will say parenthetically that UNICEF just put out a report not more than a month or two ago—and I think Lester Brown referred to it, if I am not mistaken—Global 88, a report that Third World debt has put sufficient pressure on Third World governments that they have reduced their expenditures on social programs, on education programs, on health care programs, with the result that a half a million women a year die in childbirth who wouldn't have were it not for the pressure of Third World debt and half a million infants a year die at birth or birth to 5, who wouldn't have died were it not for Third World debt pressures which have reduced not only per capita incomes in much of the Third World, especially in Central America, and have resulted in the reduction of health and education and welfare programs, but they have caused the death, as I say, of half a million of these infants and half a million mothers in childbirth. And because they have reduced family planning programs and reduced education programs, at the same time, the population growth rate is rising because of that.

Now here is the head of an important UN agency giving these horrendous results as the result of Third World debt repayment pressures on developing countries.

As I say, I don't want to overstate the problem. If I am, tell me so. What are your reactions? Any of you.

Dr. STARR. Mr. Chairman, I am sure that is absolutely the case in Latin America and Africa. As you know, Israel and Egypt are the major recipients of our aid. They also have major debt to the United States, but it is more or less overtaken by the aid that we provide them. I think what you see in the Middle East is not the pressure of Third World debt but the pressure of constant crisis in daily life, the fear of war, the fear of fear, the fear of each other and basic ignorance and lack of desire to look beyond. For example, on the greenhouse effect, when I was in Israel last summer and interviewed a number of people about their concern over the greenhouse effect, they laughed at me. They said that is another American media ploy, you know, it is a hype. We really don't see any greenhouse effect here. It gets hotter and hotter and hotter each year out there, but they don't see a greenhouse effect.

I think that you are really talking about people that are so stretched, creatively, I mean their minds are so taken up with daily crises and problems that they don't have the energy to put into trying to restructure the universe that they live in. Egypt is going to be 75 million people by the year 2000. You want to talk to them about all of these issues, and they say, well, we're just mired in trying to get through the day.

So I think that one danger of this Third World debt issue is that it may be too easy an anchor to put our worries on—"Oh, if we reduce the debt, then these people are going to do a great deal about the environment and population planning and water scarcity and problems of women". I don't think that is true at all. I don't think that they will do more or less unless we lead them, educate them and try and work with them not, in a patronizing way, but in a cooperative way.

Mr. Scheuer. And unless there are some joint obligations to do specific identifiable, provable things to lessen the damage and enhance a concept like sustainable development. I quite agree with you.

Let's hear from the other ladies on their views as to the effect of the pressure of Third World debt repayment on these countries, and do they encourage destructive and harmful practices.

Ms. Spivy-Weber. I think I would second exactly what has been said. I think Third World debt is a problem, but it is not a problem in isolation. There are a number of things that need to be worked on at the same time as we seek to reduce the debt burden. We have to look at how the gross national product is calculated globally in our various countries. We aren't putting enough stress on factoring in environmental consequences into our economic system. Our trade policies are going to have to be ecologically and environmentally sound. There are a lot of areas where we are going to have to bring the environment in where it has not been in the past—banking policies, trade policies and basic economics. I think if we work on the package and have several programs going, one of which is debt, we may make some progress.

Mr. Scheuer. Anybody else?

Ms. Baldi. I just want to say that I will agree with what they have said. I do think Third World debt, from my perspective, having worked in developing countries, is an enormous burden to people who are trying to survive, but I think there is a real fundamental question here, and that is our whole economic system, our global economic system, including our own in this country. I mean, we make money off of things that are environmentally unsound, and we are polluting ourselves to death. I think that one of the real challenges for us in this next decade is if we could come up with economic sustainability for the planet that is also environmentally sustainable.

Ms. Ofosu-Amaah. Well, many of the women at the Harare conference, and that is what I try to relate everything I say back to, because it is really the people who are out there on the land who are talking, refer to the conflicting goals. They usually talk about their own small problems and then relate that to the national level. I think that there are some interesting parallels here, parallels which they drew themselves.

The women talked about their income-generating activities. They talked about livestock raising, especially goat rearing, which throughout some of the workshops were referred to as having a very detrimental effect on the land, especially marginal land, especially in the arid areas. The goats roaming wild would clear the land in no time at all. There was a debate as to whether to ban this activity or how to deal with this major problem of goat rearing. Many women came up and said, "Look, for us, rearing a goat is one of the fastest ways of generating income. If you need money in a short time, you rear a goat. Within a couple of months, it has reached maturity, you sell it, you get your money. So what we want from the agriculturists and the policymakers is to come up with constructive ideas for paddocking, for example, where the goats will be put in paddocks or fenced off, so that this problem would be controlled at least."

They drew a parallel between that and some of their countries' activities which put extreme pressure on the current capacity of the land, specifically, cattle raising. They said in many parts, especially Botswana and Lesotho, this was necessary to provide the foreign exchange that these countries needed. So they saw a parallel between their little problem and that major problem. I think that comes back to this debt pressure, because the foreign exchange is needed in that particular instance to meet, you know, their debt service and other economic needs.

So I think, yes, that is imposing a severe pressure on environmentally sound policies.

Mr. SCHEUER. Well, thank you very much. It has been a fascinating panel, and we have gone way over our time, and we have other witnesses waiting. I am very grateful to you for your thoughtful and stimulating testimony, and I will have some additional questions for you by mail.

I ask unanimous consent to keep the record open for two weeks. Hearing no objection, so ordered. Thank you very, very much.

The next panel is Lester Brown, Charles Benbrook and Raymond Hopkins. Well, I am delighted to welcome all of you.

Lester Brown founded the Worldwatch Institute in 1974. He is the author of the widely acclaimed "State of the World Report," which is published annually, and here I have the 1989 issue hot off the press. You can still smell the ink. He is a recipient of the MacArthur Foundation Genius Award, which probably says as much about Lester Brown as we have to say. He is one of the real outspoken advocates in the world on the whole question of sustainable development. We are delighted to have you.

Dr. Benbrook is the Executive Director of the Board on Agriculture at the National Research Council. He has been there for five years and prior to that he was staff director of the Subcommittee on Research and Foreign Agriculture in the House Committee on Agriculture. He is an old friend.

Dr. Raymond Hopkins is the chair of the Political Science Department of Swarthmore College, my alma mater. What more is there to say? We are delighted to have all of you. ' I also have a staff aide who was a classmate of mine at Swarthmore College, Jacqui Russler. Jacqui, say hello to Dr. Hopkins.

Okay. Lester Brown, why don't you just chat with us for five or six minutes.

STATEMENT OF LESTER R. BROWN, PRESIDENT, THE WORLDWATCH INSTITUTE.

Mr. BROWN. Thank you, Mr. Chairman. I would like to submit for the record the chapter on the current world food situation from the "State of the World 1989", if that would be satisfactory.

Mr. SCHEUER. No objection; so ordered.

Mr. BROWN. And then just make a few points in very simple fashion. One is, as you know, during the late seventies and early eighties there was a great deal of attention paid to surpluses. One of the most frequent headlines we saw was "A World Awash in Grain." I think those headlines were influenced by the economic interpretation of surpluses, because there clearly was a build-up in stocks, prices were depressed, growth in production had been rapid in the late seventies and early eighties. Looking at those economic indicators, clearly one could not find much to worry about as far as the food situation was concerned.

The unfortunate thing is that the world's farmers were beginning to have trouble in the early seventies in keeping up with the 3 percent rate of growth in world food demand that began after World War II. That difficulty first came into focus after the Soviet wheat purchase in 1972. World prices doubled within the next year, world prices of grain. Farmers around the world, and governments, responded to those price increases by plowing a lot of land that should never have been plowed, land that would not sustain cultivation. There was a lot of investment in irrigation and a lot of investment in irrigation pumps on a scale that could not be sustained, leading to overpumping. The combination of overplowing and overpumping led to this build-up in surpluses. These were not real surpluses but those produced by borrowing from the future, in effect.

Mr. SCHEUER. They weren't produced by sustainable agricultural practices.

Mr. BROWN. That's right, exactly.

Mr. SCHEUER. As a matter of fact, you wrote a column that was, I think, in the Washington Post on exactly this subject, and you indicated that on a sustainable basis, we couldn't supply sufficient food for global needs at current population growth rates, and do you know, the parliamentarians from all over the world read that column. Are you aware of that?

Mr. BROWN. I was not, but—

Mr. SCHEUER. This is all off the record.

Mr. BROWN. No, that's all right. We can put it on the record. [Laughter.]

Mr. SCHEUER. All right. We can put it on the record. I read that column just before I left for an Interparliamentary Union conference in Budapest, in Sofia last November. We were then planning the centenary conference of the IPI which is scheduled to take place in London next September. I had been pressing them to finally face up to the food-population equation, and when I got over there, I had the secretariat reprint 200 copies of your column and I personally put it in the hand of every single delegate to that conference from all over the world. I finally was successful in getting them to make the focus of the 100th anniversary of the Interparliamentary Union next September on the food-population equation with another focus being Third World debt.

Really, this series of hearings is an outgrowth of that, because I wanted to put some more pieces of paper into the hands of those delegates before they show up in September to give them something of a background in this whole question, and that is what created this set of hearings, and that article of yours made a tremendous impression. It is perfectly clear that unless we are going to constantly degrade our water levels, constantly put land under production that shouldn't be in production, we are not going to be able to meet the food needs of the population as it is currently expanding, and we have to look at rational population measures to reduce the population growth rate.

I don't know if you even remember that article, but I remember it very clearly, and it had a global impact, I can tell you, on global decision-makers, several hundred of them.

Well, please proceed. I regret the interruption.

Mr. BROWN. That is encouraging. One writes these things, and you never quite know where they are going to end up, and it is nice to know that they end up in the hands of some of the world's key decision-makers. Thank you.

Let me just cite a few numbers to give a sense of the unsustainable use of resources. As you know, under the Food Security Act, we are in the process of retiring 40 million acres of cropland in this country, of highly erodible crop land, which is being converted to grassland or to woodland. That is about 11 percent of our total crop land area. In the Soviet Union, which does not have a conservation reserve program, they have retired—they have abandoned 13 percent of their crop lands since 1977, almost 1 percent a year. Instead of retiring it while it is still productive and getting in grass or something else, they keep plowing it until there is no topsoil left, to speak of, and then they abandon it.

China, meanwhile—I am just citing the world's three largest food producers to give a sense of the trends—China, since '78, has lost 7 percent of its crop land, not so much through erosion as through conversion to nonfarm uses. The 12.5 percent annual rate of industrial growth since 1980 has meant they have been building thousands of factories every year. They have to build the factories where the people are and the people are where the crop land is. In addition, the affluence in China has translated into enormous demand for housing, and if you travel around the countryside in China today or any time in the last few years, you will see—you get the impression that everyone and his brother is either adding a new room to the house or building a new home. Again, much of that construction is taking place at the expense of crop land.

So the pressures on land resources around the world are becoming much more apparent now than they have been in the past, and we see a somewhat similar situation with water, and again, I won't go into great detail, except to say in the world's two largest food producing countries, the United States and China, the irrigated area has been declining for several years now, largely as the result of overpumping, but to some degree because water is being diverted from agriculture to industrial and to urban uses.

In the Soviet Union, they face a serious problem with the Aral Sea drying up, as they divert the river water, and that is a major ecological catastrophe in its own right, which they recognize. I won't describe it in detail.

So the resources, the soil and water resources are beginning to slow the growth in world food output.

A second thing that is beginning to operate, and Chuck Benbrook may have more to say about this, is that the new technologies that are needed to sustain rapid growth in agriculture do not seem to be there. Between 1950 and 1984, we increased world grain output—we, the world—by 2.6 fold. That is, we more than doubled, less than tripled world grain output, and there were four technologies that played a central role in that. One was hybrid corn. One was the ninefold increase in the use of chemical fertilizer between '50 and '84. The third was the near tripling of the world's irrigated area between 1950 and 1980, and the fourth was the rapid spread of the high-yielding dwarf wheats and rices in developing countries during the seventies and early eighties.

None of those technologies has run its course entirely, but in many parts of the world, there is not now a lot of opportunity left for increasing output through some of those technologies. In this country, almost all the corn is hybrid corn, for example. We can't repeat that process. If we were to double our use of fertilizer in the United States this year, you might not even see it on the production trend. That is to say, the use of additional fertilizer does not now make a great deal of difference on production.

So we have seen this overall loss of momentum that has been particularly dramatic since 1984, as the world's farmers are retrenching from the overplowing and the overpumping and so forth, and as the new technologies that are available are becoming limited.

Mr. SCHEUER. Are they retrenching from overfarming and overirrigation?

Mr. BROWN. They are. Either because in this country we have the Conservation Reserve Program that is converting land to grassland or woodland or in the Soviet Union because they are abandoning. I mean, abandonment is a form of retrenchment. It is not the form that we would like to see, but that is what is happening. So the answer is, they are beginning to. The overplowing and overpumping, by definition, are possible only in the short run, and for many of the world's farmers, the short run is coming to a close.

Against this overall loss of momentum, we had the Indian monsoon failure in 1987, and we had the drought in 1988, the North American drought. The net effect of this has been to reduce world grain reserves from the record level of 101 days equivalent of world consumption at the beginning of 1987 to less than 60 days at present. When you get down below 60 days, you don't have much more than pipeline supplies, and we have seen the effect on prices. World grain prices today are up by roughly half of what they were in, say, early last year.

This leaves us in a rather vulnerable situation, and we now face a scenario, a couple of possible scenarios. One is the "what if" scenario. What if we have another drought in the United States this year similar to the one we had last year? Now last year, as you probably know, we did not produce enough grain to satisfy our own needs. We produced 196 million tons of grain; we are consuming 206 million tons. So we actually have a small grain deficit. Now that's not been a major problem for us, because we have simply taken those 10 million tons out of reserves. At the same time, we annually export roughly 100 million tons of grain, and we are satisfying those export demands entirely by drawing down our stocks. In effect, we are exporting our reserve.

Now, as the 1989 harvests begin, reserves are at a very low level, and if we have another drought in the United States this year like last year, we will find ourselves with very little grain to export. For the first time since North America emerged as the world's breadbasket a half century or so ago, there wouldn't be any grain to supply the 100 or so countries that regularly import grain from us.

So the question is, what would be the economic effect? The answer is, no one knows, because we have never been in a situation like this before. World grain prices could double, triple, quadruple. The shock waves that would go through the world economy would probably dwarf those of the oil price hikes of the seventies.

The Department of Agriculture's word for this scenario is the "catastrophe" scenario. Now the most dramatic effect, of course, would be on Third World countries, where people are already spending easily 70 percent of their income on food, and if the price of grain—they buy their food as grain not as bread or in processed form. If the price of grain doubles or triples, they are in trouble. They simply will not be able to survive. So this leads to a political scenario of a great deal of instability, and we know from the countries in the Third World that have tried to raise food prices from time to time over the last year or two—in Africa, Zambia, Egypt, Algeria, for example, that riots and political instability are the inevitable result. So that is one scenario.

The other scenario is, what if the world has a reasonably good weather year this year for the world as a whole? We are so far off trend in production now, that it will take at least a couple of hundred million tons just to get back to where we ought to be, where we were in per capita terms, say, four years ago. It is easy to see how, with normal weather, we would get another hundred million tons in this country, but it is not so easy to see how we get that second hundred million tons. The result is that one could look at a normal harvest in 1989 but with no significant stock rebuilding, which means the world could now be in a situation where we will have to live with very modest reserves, decidedly inadequate, particularly if we are now dealing not only with the vagaries of weather but the possibility of climate change.

Dr. Jim Hansen of NASA says he is 99 percent certain that warming is under way. I think most meteorologists think the odds favor that, but not all as high as 99 percent. We do know we have had three severe droughts in this country since 1950. All three have occurred during the eighties and all three have occurred during one of the five warmest years for the world as a whole.

The final two points I would make, and incidentally, if we are now in the early stages of warming, and the world's three largest food producers last year each had reduced harvests—China's grain harvest down by 3 percent; the Soviet's down by 9 percent; we were down by 30 percent. If we are on the edge of a warming, then food security becomes a much more important issue and the level of prudent reserves, the level that was prudent when we were just dealing with the vagaries—the year-to-year vagaries of weather—becomes much higher, if we are dealing with climate change as such.

My concluding two points, and these are the two concluding points in "State of the World" this year where food is concerned, one, we think that achieving an acceptable balance between food and people during the nineties is going to depend much more on family planners than farmers. And the second point is that it may well be over the longer term that energy policymakers will have as much influence on long-term food production trends as agricultural policymakers, because of their effect on the build up in greenhouse gases.

In conclusion, if you want a really simple model of the world food economy, you can look at it in both demand and supply terms. The world's farmers each year are now trying to feed 86 million more people, and they are trying to do it with 24 billion fewer tons of topsoil each year. That is the net loss to erosion that we estimate. That is about the amount of topsoil on Australia's wheatland. So it is not an inconsequential amount. So each year 86 million more people, 24 billion fewer tons of topsoil. At some point, one of those trends will have to give. There is evidence that the population trend is beginning to give in some countries, as infant mortality rates climb. The UNICEF report that you referred to earlier points out that infant mortality rates were declining, in part, because of UNICEF's very good programs in a number of countries, but in the last few years they are beginning to turn up as the increase in malnutrition begins to override the positive effects of such things as vaccination, breast feeding, oral rehydration therapy, et cetera, et cetera.

My colleague, John Young, who is sitting behind me, has written an article in our magazine on the Island of Madagascar, a country of 11 million people off the eastern coast of Africa, pointing out how their per capita food consumption peaked the same year as for Africa, the continent as a whole, and has been declining since. It is now clearly contributing to an increase in malnutrition and hunger. Food production is falling. They don't have the foreign exchange to import. So it is belt tightening among people who don't have any notches left in some cases. The infant mortality rate has gone from something like 105 to 130 over the last several years with nothing in prospect to reverse that rise. Unfortunately, we are now beginning to see increases in infant mortality rates in countries like Ghana, Brazil, Peru, many of the countries in Africa. Unfortunately, we don't have good data for most of them.

Thank you.

[The prepared statement of Lester R. Brown follows.]

Worldwatch Institute

1776 Massachusetts Ave., N.W. • Washington, D.C. 20036 • (202) 452-1999

STATEMENT

OF

LESTER R. BROWN

PRESIDENT, WORLDWATCH INSTITUTE

BEFORE THE

SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE

RESEARCH, AND THE ENVIRONMENT

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

U.S. HOUSE OF REPRESENTATIVES

FEBRUARY 28, 1989

3

Reexamining the World Food Prospect

Lester R. Brown

At the start of the 1987 harvest, world grain stocks totaled a record 459 million tons, enough to feed the world for 101 days. When the 1989 harvest begins, the "carryover" stocks will likely drop to 54 days of consumption, lower even than the 57 days at the beginning of 1973, when grain prices doubled. During a brief two years, world reserves of grain—which account for half of all human caloric intake when consumed directly and part of the remainder in the form of meat, milk, cheese, butter, and eggs—will have plummeted from the highest level ever to the lowest since the years immediately following World War II.[1]

Stocks have declined precipitously because food demand has continued its population-driven rise while production has fallen at a record rate. In 1987, a monsoon failure in India contributed to an 85-million-ton drop in world output. In 1988, drought-reduced harvests in the United States, Canada, and China reduced world grain output a further 76 million tons.[2]

The drought that afflicted the United States in 1988 is by many criteria the most severe on record—so severe that domestic grain production has fallen below consumption for perhaps the first time ever. North America, which supplies most of the world's wheat and feedgrain exports, is able to maintain exports during the 1988/89 trade year only by selling its carryover stocks. A severe drought in 1989 will reduce exports to a trickle, creating a world food emergency.[3]

The central question raised by this overnight depletion of world grain reserves is, What are the odds that North America will experience another severe drought in 1989? Are the three drought-reduced harvests of 1980, 1983, and 1988 simply reruns of the types of droughts that occurred in the thirties, or do they foreshadow an agricultural future in a world where summers in mid-

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An expanded version of this chapter appeared as Worldwatch Paper 85, *The Changing World Food Prospect: The Nineties and Beyond.*

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*This statement is excerpted from State of the World 1989 (New York: W.W. Norton, 1989), Chapters 1, 3, and 10.

continental North America will be far hotter? No one knows.

Drought can be caused by below-normal rainfall, by above-normal temperatures (which increase evaporation), or both, as was the case in 1988. Record-high temperatures in key U.S. agricultural areas during the summer of 1988 contributed to the reduced harvest. This unprecedented summer cannot be conclusively linked to the long-projected global warming, but both the reduced rainfall and the higher temperatures in the North American agricultural heartland are consistent with projected changes in climate associated with the buildup of greenhouse gases. Many meteorologists believe it is likely that the warming is now under way. If so, droughts and heat waves will occur with increasing frequency, making it more difficult to rebuild stocks once they are depleted. (See Chapter 1.)[4]

The future of agriculture is being shaped increasingly by environmental trends and resource constraints.

In addition to the drought-reduced harvests, the growth of world food production appears to be losing momentum. Between 1950 and 1984, world grain output climbed from 624 million tons to 1,645 million tons, a prodigious 2.6-fold gain that raised per capita grain production by 40 percent. Since then, output per person has declined each year, falling 14 percent over the last four years. In part, this fall measures the unsustainable use of soil and water.[5]

No one knows what share of world food output is unsustainable, but some idea of its scale can be gleaned by looking at U.S. agriculture. Under the Conservation Reserve Program, the U.S. Department of Agriculture (USDA) is taking 11 percent of the country's cropland out of production, converting it to grassland or woodland, because it is too erodible to sustain continuous cropping. Irrigated area has shrunk 7 percent since 1978. Even so, water tables are still falling by six inches to four feet per year beneath one fourth of U.S. irrigated cropland, suggesting that further shrinkage is in prospect.[6]

If the estimated 57 million tons of U.S. grain output—roughly one sixth of the total—produced with this unsustainable use of soil and water is subtracted from world output, the surpluses of the eighties disappear. More seriously, subtracting unsustainable output for the United States alone from world food production puts sustainable world production below consumption.[7]

Depressed farm prices during the eighties have clearly slowed investment in agriculture, but other forces are shaping the world food prospect. For instance, the backlog of unused agricultural technologies that farmers can draw upon in some countries is dwindling, making it more difficult for them to maintain the rapid output growth of recent decades.

But beyond these economic and technological influences, the future of agriculture is being shaped increasingly by environmental trends and resource constraints. Prominent among these are the continual loss of topsoil from croplands, the conversion of cropland to nonfarm uses, the waterlogging and salting of irrigation systems, falling water tables, the diversion of irrigation water to nonfarm uses, and now the possible adverse effects of climate change.

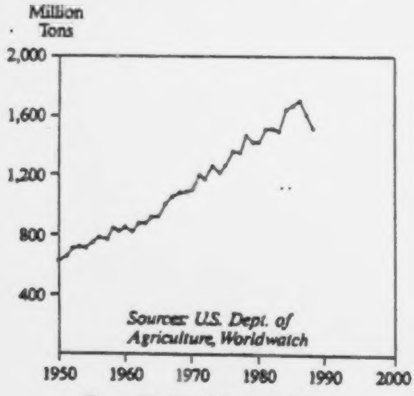
In addition, demographic trends are making it ever more difficult to achieve a satisfactory balance between food and people. The annual addition to world population, estimated at 86 million in 1988, is projected to exceed 90 million in the early nineties. By the end of the decade, there will be nearly a billion more people to feed. In the two regions with the fastest population growth, Africa and Latin America, per capita grain production is falling. If action is not taken soon to reverse these declines, hunger and malnutrition will spread, and eventually food consumption for more people will fall below the survival level.[8]

PRODUCTION TRENDS

The enormous growth in world grain output between 1950 and 1984 has no precedent. Never before had the world witnessed such an increase in food production within one generation. But can this rapid growth be restored and sustained indefinitely?

The last four years may help answer these questions. After increasing only slightly in 1985 and 1986, global grain production fell sharply in 1987 and again in 1988. (See Figure 3–1.) As noted earlier, in per capita terms it has fallen each year since 1984.[9]

The overall loss of momentum in world grain output, exacerbated by the monsoon failure in India in 1987, the North American and Chinese droughts in 1988, and large areas of cropland idled under U.S. commodity supply management programs in both years, has depressed the world grain harvest by nearly 10 percent in two years. Record back-to-back declines have interrupted nearly four decades of steady growth in world grain output, one of the most predictable of global economic trends since World War II.



Source: U.S. Dept. of Agriculture, Worldwatch

Figure 3-1. World Grain Production, 1950-88

During the mid-eighties, grain production plateaued in some of the world's most populous countries, including India, Indonesia, Mexico, and China. India more than tripled its wheat harvest between 1965, when the Green Revolution was launched, and 1983, sharply boosting total grain output. Since then, grain production has not increased there at all.[10]

Indonesia doubled its grain harvest, consisting almost entirely of rice, between 1970 and 1984, but output has since leveled off. Indonesia's resettlement program, designed to alleviate land hunger by moving people from densely populated Java to the outer islands, has been widely judged a failure and has nearly halted. In contrast to Java's rich soils, those of the outer islands typically deteriorate, and rather quickly, once the dense rain forest is cleared for farming.[11]

Mexico, where the Green Revolution originated, boosted its grain harvest fourfold between 1950 and 1984. There, too, production has stagnated, largely because the area in grain has declined one tenth during the eighties. This shrinkage, as degraded cropland is abandoned and as some areas are converted to nonfarm uses, is offsetting the gains in yield per hectare.[12]

China may illustrate the leveling off most dramatically. The economic reforms that quickly led to exploitation of a large backlog of unused technologies boosted grain production by nearly half between 1976 and 1984, an impressive achievement by any standard. Since then, China's output has actually fallen slightly. Beijing's official goal early in 1988 was to regain the record level of 1984. Notwithstanding an increase in grain procurement prices for the 1988 crop, China's efforts to regain the 1984 harvest level failed for the fourth consecutive year.[13]

The food prospect for China is of special concern, not merely because it is the world's largest consumer, but because its planners may be greatly overestimating future gains in production. They project a 130-million-ton increase in grain production by the end of the century, or roughly a third, but is this really feasible? The recent experience of three other countries in East Asia with similar population/land ratios, and that have undergone rapid industrial development comparable to that now under way in China, calls this goal into question.[14]

In Japan, Taiwan, and South Korea, grain production has been declining for many years. In each of the three, the historical peak came during the 11-year span between 1967 and 1978. From their respective peaks, production has declined more than one fourth in Japan, by one fifth in Taiwan, and by one sixth in South Korea.[15]

The reasons for these common trends are clear. With a small area of cropland per person, it becomes difficult to boost output per worker in agriculture as fast as in industry. The rapid rise in labor productivity and income in the industrial sector pulls workers out of agriculture. As a result, the area multiple-cropped—growing more than one crop per year in one field—begins to decline. In addition to siphoning labor out of agriculture, the nonfarm sector also draws land away from farmers. Record rates of industrialization lead to rapid growth in land used for the construction of factories, warehouses, access roads, and, as affluence rises, new housing. In each of these East Asian countries, the decline in grain area was followed in a matter of years by a decline in grain production.

For densely populated countries that are industrializing rapidly, the comparative advantage lies in industry, not in agriculture. As a result, these three countries have greatly increased their grain imports over the last decade or two—an obviously sensible policy. Although all three are largely self-sufficient in rice, they import most of their wheat and nearly all of their feedgrains. In 1987, imports accounted for 71 percent of Japan's grain consumption, 72 percent of Taiwan's, and 59 percent of South Korea's.[16]

Eastern Europe and the Soviet Union are slowly reducing their dependence on outside grain.

The experience of these three countries may explain why China is now having such difficulty boosting grain production. Like its neighbors, China is densely populated and has a small area of cropland per person, a rapid rate of industrial development, and a nonfarm sector that is pulling both labor and land away from agriculture. In addition, in China's water-scarce north, the nonfarm sector is diverting water from irrigation.[17]

China's grain area peaked in 1976, just 12 years before grain production did the same. With grain yield per hectare already four fifths of that in Japan, achieving the yield increases that are needed to reach the one-third increase planned by the year 2000 will not be easy.[18]

In 1988, China imported 5 percent of its grain, roughly 15 million tons. If the nation's efforts to expand output are no more successful than those of its three smaller neighbors, it might be importing a steadily growing share of its food during the nineties. If China were to import 15 percent of its needs by 1995, the amount would total 45 million tons—more than the 28 million tons now bought by Japan and the 24 million tons by the Soviet Union, the world's leading grain importers.[19]

Perhaps the best indicator of long-term shifts in food production relative to demand can be seen in the changing geographic pattern of world grain trade. (See Table 3–1.) In 1950, most of the grain in international trade flowed from North America to grain-deficit Western Europe. The rest of the world was essentially self-sufficient. That has changed dramatically in recent decades. Since mid-century, North America has increased its grain exports more than five-fold, from 23 million to 119 million tons, emerging as the world's breadbasket.

Latin America became a grain-deficit region in the seventies, with net imports of roughly 11 million tons by 1988. Despite a vast land area, Brazil now regularly imports both wheat and feedgrains. These imports plus those of Mexico, with its growing food deficit, and of several smaller countries more than offset exports from Argentina.[20]

Africa, a largely agrarian continent beset by environmental deterioration and a record population increase, has become heavily dependent on imported grain as it tries to offset a two-decade decline in per capita production. The northern tier of countries—Egypt, Libya, Tunisia, Algeria, and Morocco—now bring in half the grain they consume. Even with continental imports of an estimated 28 million tons in 1988, millions of people in sub-Saharan Africa were left hungry and malnourished, some on the verge of starvation.[21]

The combination of a small and shrinking cropland area per person and rising prosperity in many countries has made Asia the leading food-importing region. Its purchases surpassed those of Europe during the mid-sixties, and all indications are that they will continue to rise during the nineties and beyond.

Eastern Europe and the Soviet Union, which were importing at record levels in the late seventies and early eighties, are slowly reducing their dependence on outside grain. Whether they reach self-sufficiency will depend heavily on the success of Soviet agricultural reforms.

Western Europe is perhaps the most interesting regional story. In the early eighties, it ended two centuries of dependence on imported grain, a dependence that began with the industrial revolution and the exchange of manu-

Table 3-1. The Changing Pattern of World Grain Trade, 1950–88[1]

Region	1950	1960	1970	1980	1988[2]
			(million metric tons)		
North America	+23	+39	+56	+131	+119
Latin America	+ 1	0	+ 4	− 10	− 11
Western Europe	−22	−25	−30	− 16	+ 22
E. Eur. and Soviet Union	0	0	0	− 46	− 27
Africa	0	− 2	− 5	− 15	− 28
Asia	− 6	−17	−37	− 63	− 89
Australia and New Zeal.	+ 3	+ 6	+12	+ 19	+ 14

[1] Plus sign indicates net exports; minus sign, net imports. [2] Preliminary.

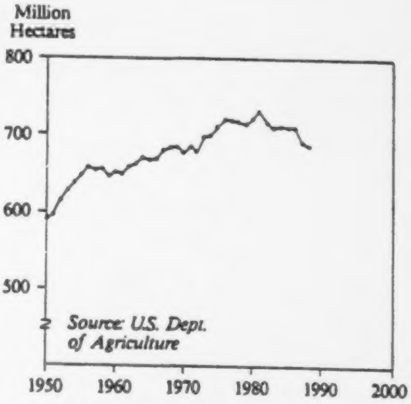
SOURCES: U.N. Food and Agriculture Organization, *Production Yearbook* (Rome: various years); U.S. Department of Agriculture, Foreign Agricultural Service, *World Rice Reference Tables* and *World Wheat and Coarse Grains Reference Tables* (unpublished printouts) (Washington, D.C.: June 1988).

factured goods for food and raw materials with the rest of the world. Steadily advancing farm technologies, farm support prices well above the world market level, and a population growth rate that is approaching zero have combined to push the region's net exports above those of Australia. Although West European farmers could face some reductions in support prices as the costs of maintaining current levels soar, they still may be able to sell more grain abroad than Australia, which with its semiarid climate will find it difficult to increase exports substantially.

Until recently, expanding food production was largely an economic concern, a matter of formulating agricultural price policies that would stimulate investment. Today, rises in commodity support prices in some countries may simply result in the plowing of highly erodible land or the installation of more irrigation pumps where water tables are already falling. Given the soil and water constraints now facing farmers, the slower growth in food output of recent years is not surprising.

THE CROPLAND BASE

From the beginning of agriculture until the mid-twentieth century, most of the growth in world food output came from expanding the cultivated area. Since 1950, a combination of the diminishing fertility of new land to plow and the availability of new technologies shifted the emphasis from plowing new land to raising land productivity. Roughly four fifths of the growth in world food output since mid-century has come from this source.[22]



Source: U.S. Dept. of Agriculture

Figure 3-2. World Harvested Area of Grain, 1950-88

The world grain area increased some 24 percent between 1950 and 1981, when it reached an all-time high. (See Figure 3-2.) Since then, it has fallen some 7 percent. That the world's cropland area would expand when the world demand for food was growing rapidly is not surprising. What is surprising—and worrying—is the recent decline. This is due partly to the abandonment of eroded land, as in the Soviet Union; partly to the systematic retirement of such land under conservation programs, as in the United States; and partly to growing competition from nonfarm sources, a trend most evident in densely populated Asia.[23]

From mid-century until 1981, two major surges in the world grain area occurred. The first came in the early fifties, when the Soviets embarked on the Virgin Lands project. Between 1951 and 1956, they added some 40 million hectares to their cropland base, accounting for most of the steep growth in the world grain area.[24]

The second surge began when world grain prices doubled between 1972 and 1973. Farmers throughout the world responded to record prices by plowing more land. In the United States, they not only returned idled cropland to use, they also plowed millions of acres of highly erodible land. Between 1972 and 1976, the U.S. area in grain climbed some 24 percent. But soil erosion increased as well. By 1977, American farmers were losing an estimated six tons of soil for every ton of grain they produced.[25]

Meanwhile the Soviet Union, embarrassed by its 1972 crop failure, expanded its area in grain some 7 percent. By 1977, it had reached a record high. But erosion of soil by both wind and water also increased. Although detailed data on soil loss are not available, papers published by the Soil Erosion Laboratory at the University of Moscow indicated severe and worsening erosion.[26]

In early 1982, Mikhail Gorbachev, then only a Politburo member, urged planners to heed the advice of soil scientists and adopt measures to limit erosion. But in the face of pressures to reduce food imports—then the world's largest—the scientists often were ignored and responsible management practices cast aside.[27]

Soil erosion is making future production gains more difficult in China as well. The Yellow River Conservancy Commission reported in 1980 that the Huang He, or Yellow River, was depositing 1.2 billion tons of soil in the ocean each year. At the Mauna Loa observatory in Hawaii, scientists taking air samples can tell when spring plowing starts in China by the surge of dust carried eastward by prevailing winds.[28]

Perhaps the grimmest soil erosion report came in a 1978 dispatch from the U.S. embassy in Addis Ababa, stating that an estimated 1 billion tons of topsoil were washing down from Ethiopia's highlands each year. The result for that country has become well known: recurrent famine, a window on the future of other developing countries that are failing to control soil loss.[29]

The use of land for building is also shrinking the cropland area. In China, one result of the past decade's welcome prosperity is that literally millions of villagers are either expanding their existing dwellings or building new ones. And an industrial sector expanding at more than 12 percent annually since 1980 means the construction of thousands of new factories. Since most of China's 1.1 billion people are concentrated in its rich farming regions, new homes and factories are often built on cropland. This loss of agricultural land combined with the shifts to more profitable crops has reduced the grain-growing area in China 9 percent since 1976.[30]

Throughout the Third World, mounting population pressures continue to push farmers onto lands too steeply sloping to sustain cultivation and semiarid lands too dry to be protected from the winds when plowed. As erosion continues, land gradually loses its inherent productivity, threatening the livelihood of those who depend on it.

Continual overuse of biological systems can set in motion changes that become self-reinforcing.

During the eighties, the results of this process became clear. Researchers now realize that continual overuse of biological systems can set in motion changes that become self-reinforcing. World Bank ecologist Kenneth Newcombe has described how complex systems unravel through several stages, each of which hastens the onset of the next. His model, drawn from the experience of Ethiopia, shows how a decline in biological productivity can be triggered by a loss of tree cover.[31]

All too often, this starts when the firewood demands of growing populations begin to exceed the sustainable yield of local forests. As the woodlands recede from the towns, firewood becomes scarce. At this point, villagers start using crop residues and animal dung for cooking. This interrupts two important cycles, depriving the land of nutrients and also of the organic matter essential to maintaining a productive soil structure. As protective vegetation disappears and as soils become more compact, more rainfall runs off, soil erosion accelerates, less water is absorbed by the soil, and the soil moisture needed for healthy crops diminishes. Water tables begin to fall. Over time, wells go dry. Eventually, not enough soil is left to support even subsistence-level agriculture. At this point, villagers become environmental refugees, heading for the nearest city or relief camp. (See Chapter 4.)

Official recognition of this cycle of land degradation and its consequences is emerging in India. Agronomists there estimated that their country, with the same cropland area as the United States, was losing some 5 billion tons of topsoil each year as of 1975, compared with a U.S. loss of just over 3 billion tons. In 1985, Prime Minister Rajiv Gandhi set up a National Wastelands Development Board; its aim is to transform 5 million hectares of degraded land every year into fuelwood and fodder plantations.[32]

This grim process of eroding soils is leading the world into a period of agricultural retrenchment. Even ignoring the cropland idled under U.S. commodity programs, the world area in grain has declined steadily since reaching the historical high in 1981. The United States is in the midst of a five-year program to convert at least 40 million acres (16 million hectares) of highly erodible cropland—11 percent of its total cropland—to grassland or woodland before it becomes wasteland. (See Table 3–2.)[33]

In contrast, the Soviet Union does not have a program for converting highly erodible land to less-intensive, sustainable uses. As a consequence, each year since 1977 it has abandoned roughly a million hectares of cropland, leading to a 13-percent shrinkage in grain area. Abandonment on this scale suggests that inherent fertility may be falling on a far larger area, helping explain why the Soviets now lead the world in fertilizer use while still ranking a distant third in grain production after the United States and China.[34]

In some developing countries, cropland degradation from erosion is leading to the wholesale abandonment not only of cropland, but of entire villages. Across the southern fringe of the Sahara Desert, thousands of villages and their surrounding farmlands are surrendering to the sand. Declining rainfall and desertification are forcing the agricultural frontier to retreat southward across a broad band of Africa, from Mauritania in the west to the Sudan in the east.[35]

As the eighties draw to a close, such

Table 3-2. United States: Sign-Up for Conservation Reserve Program, March 1986–July/August 1988

Sign-up Period	Area Signed Up	Average Annual Rental Rate Per Hectare
	(million hectares)	(dollars)
March 1986	0.30	104
May 1986	1.12	109
August 1986	1.90	116
February 1987	3.84	126
July 1987	2.14	119
February 1988	1.38	119
July/August 1988	1.05	121
Total	11.73	120

SOURCES: U.S. Department of Agriculture (USDA), Economic Research Service (ERS), *Agricultural Resources: Cropland, Water, and Conservation Situation and Outlook Report* (Washington, D.C.: September 1987); "Sixth CRP Signup Adds 3.4 Million Acres," *Agricultural Outlook*, August 1988; data for July/August 1988 are preliminary Worldwatch estimates based on Tim Osborn, USDA, ERS, private communication, November 1, 1988.

data as are available indicate that soil erosion is slowly reducing the inherent productivity of up to one third of the world's cropland, though increased use of chemical fertilizers is temporarily masking this deterioration. Worldwide, an estimated 25 billion tons of topsoil is being lost from cropland each year, roughly the amount that covers Australia's wheat lands.[36]

WATER FOR IRRIGATION

The spread of irrigation from its initiation in the Middle East several thousand years ago has been dramatic, as detailed in *State of the World 1987*. At the start of this century, the world total stood at some 40 million hectares. By 1950, it had reached 94 million hectares; by 1980, 249 million hectares. After 1980, however, growth slowed dramatically, expanding by an estimated 8 million hectares since then. (See Figure 3-3.)[37]

Irrigation often holds the key to cropping intensity, especially in monsoonal climates, where the wet season is followed by several months with little or no rain. Where temperatures permit year-round cropping, as they often do where monsoons prevail, irrigation allows the production of two, three, or even more crops per year.

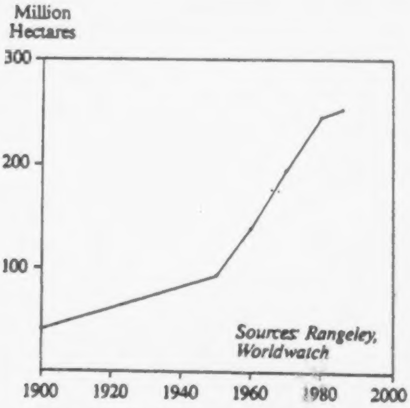


Figure 3-3. World Irrigated Area, 1900-85

China and India lead the world in irrigated land. In China, this agricultural practice grew impressively between 1950 and 1980, increasing from scarcely 20 million hectares in 1950 to some 48 million by 1980. The growth facilitated an increase in multiple cropping, from an average of 1.3 crops per hectare in 1950 to 1.5 in 1980.[38]

India's net irrigated area in 1950 was almost exactly the same as China's. Though growth has been less rapid, the total nonetheless reached some 39 million hectares as of 1980. The most rapid growth has occurred since the mid-sixties, following the introduction of high-yielding wheat and rice varieties that were both more responsive to the use of water and more exacting in their demands. This enhanced profitability stimulated widespread investments by small farmers in wells of their own so they could more fully exploit the yield potential of the new varieties.[39]

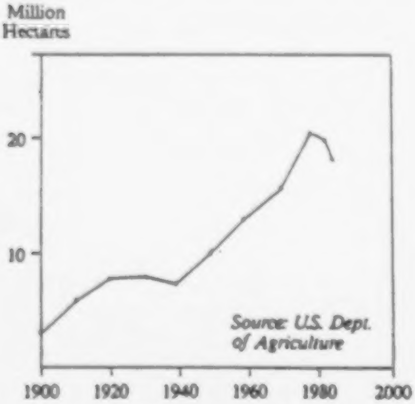
The United States and the Soviet Union rank third and fourth, respectively, in irrigated area. Growth in U.S. irrigated area from 1950 to 1980 was concentrated in the southern Great Plains. Soviet irrigated area grew steadily during the same period. With some 18 million hectares already under irrigation in 1983, the government planned to add over 600,000 hectares a year during the mid-eighties. The Soviets look to irrigation not only to help boost food production but also to minimize the wide swings in crop output that result from highly variable rainfall.[40]

Unfortunately, not all of the irrigation expansion during the preceding three decades is sustainable. Some, as in the U.S. southern Great Plains, is based on the use of fossil water, which will eventually be depleted. In other parts of the

United States and in other countries, some irrigation growth has resulted in the drawing down of water tables as pumping exceeds aquifer recharge. In addition, the water available for irrigation is being reduced in still other areas by the growing water demands of industries and cities.[41]

In recent years, the world's two leading food producers—the United States and China—have experienced unplanned declines in irrigated area. The U.S. irrigated area, which peaked in 1978, has fallen some 7 percent since then, reversing several decades of growth. (See Figure 3–4.) In addition to falling water tables, depressed commodity prices and rising pumping costs have contributed to the shrinkage.[42]

Further declines are in prospect. In 1986, USDA reported that more than one fourth of the 21 million hectares of irrigated cropland was being watered by pulling down water tables, with the drop ranging from six inches to four feet per year. They were falling either because the pumping exceeded the rate of aquifer recharge or because the water was from the largely nonrenewable Ogallala Aquifer. Although water mining is an option in the short run, in the long run withdrawals cannot exceed aquifer recharge.[43]



Source: U.S. Dept. of Agriculture

Figure 3-4. Irrigated Land in the United States, 1900-84

In China, where the expansion also peaked in 1978, irrigated area had shrunk 2 percent by 1987. Under parts of the North China Plain in the region surrounding Beijing and Tianjin, the water table is dropping by one to two meters per year. Industrial, residential, and agricultural users compete for dwindling supplies of fresh water. Deterioration in some community irrigation systems is also evident due to neglect arising from the shift to family-centered farming.[44]

Overpumping is evident in India as well. Although no groundwater study comparable to the USDA survey has been done, several states have reported that water tables are falling and that wells are going dry. In Tamil Nadu, on India's eastern coast, the water table in some areas fell 25–30 meters during the seventies. In Maharashtra, on the west coast, competition is growing between large-scale producers of commercial crops, such as sugarcane, and local villagers who are producing food staples for their own consumption. As commercial growers invest in deeper wells, they lower the water table, and the shallow, hand-dug wells of the villagers go dry. Thousands of Indian villages now rely on tank trucks for their drinking water. Notwithstanding widespread water shortages in some states, there is still a large potential for irrigation expansion in parts of India, such as in the water-rich Gangetic Plain.[45]

In the Soviet Union, the excessive use of water for irrigation takes the form of diminished river flows rather than falling water tables. A good part of the nation's irrigated cropland is in central Asia, and much of it is watered by the Syr-Darya and Amu-Darya, the two great rivers of the region. Irrigation diversions from these rivers have greatly reduced their flow into the landlocked Aral Sea. As a result, the sea's water level has fallen some 12 meters since heavy river diversions got under way some two decades ago.[46]

Since 1960, the area covered by the Aral Sea has shrunk by 40 percent. Muynak, once a port city and major fish-processing center, is now nearly 50 kilometers from the shore. Soviet scientists fear a major ecological catastrophe is unfolding as the sea slowly disappears. The dry bottom is now becoming desert, the site of sandstorms that may drop on the surrounding fields up to half a ton per hectare of a sand-salt mix—damaging the very crops that water once destined for the sea is used to grow.[47]

The Soviet Union's prospects for future irrigation expansion are limited. Two years ago, the government abandoned its ambitious plan to divert southward into central Asia the Siberian rivers that flow into the Arctic Ocean. Although investment in irrigation continues, the prospective net gains are modest ones.[48]

Apart from the growing scarcity of fresh water, the productivity of perhaps one third of the world's irrigated land is being adversely affected by severe waterlogging and salting. (See also Chapter 2.) Like soil erosion, this process at first gradually reduces land productivity and eventually leads to abandonment.

If underground drainage of irrigated land is not adequate, percolation from river water diverted onto farmland gradually accumulates and over time slowly raises the water table until it moves to within a few feet of the surface. As a result, deep-rooted crops begin to suffer. As the water table continues to rise, it begins evaporating through the remaining inches of soil into the atmosphere, leaving salt on the surface and reducing the land's productivity.

With all natural water containing a certain amount of salt, the buildup of this natural compound is a common threat to the sustainability of irrigated agriculture. As long as the hydrodynamics of the irrigation system provide sufficient flushing, salt does not accumulate in the surface soil. But in many semiarid and arid regions, this is not the case.

The productivity of one third of irrigated land is being adversely affected by severe waterlogging and salting.

Worldwide, the prospects for major gains in irrigated area are not good. To be sure, India's irrigated area is projected to expand steadily in the years ahead, and the Soviet Union's continuing investments will lead to some modest increases. In several of the smaller countries of Asia, such as Thailand and the Philippines, naturally flooded riceland is being converted to irrigated riceland, a shift that permits farmers to raise yields dramatically. At least some developing countries on each continent are planning new additions to their irrigated land. As food prices go up, investment in irrigation will also rise. But as noted earlier, irrigated area in the United States and China has declined in recent years and may well drop further.[49]

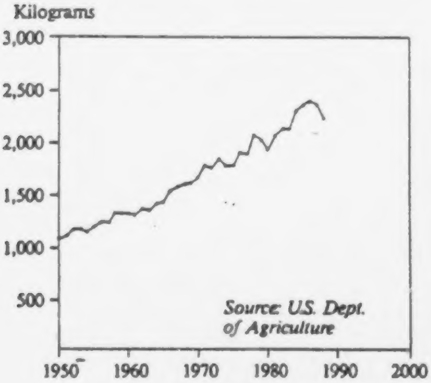
On balance, it now seems unlikely that the world will be able to reestablish a trend of rapid, sustained gains in irrigated area of the sort that characterized the period from 1950 to 1980. In retrospect, this three-decade growth era will probably be seen as unique. To the extent that the irrigated area expands in the future, it may depend as much on gains in water-use efficiency as on new supplies.[50]

LAND PRODUCTIVITY POTENTIAL

The ancients calculated yield as the ratio of grain harvested to that sown. For them, the scarce resource was the seed grain itself. In the late twentieth century, land is becoming the constraint. The key to meeting future needs is raising land productivity.

With little opportunity to add productive land to the world's cultivated area, the food prospect in the nineties is directly tied to the potential for raising land productivity. Between 1950 and 1984, farmers more than doubled the output of their cropland. World grain yield per hectare increased from 1.1 tons to 2.3 tons, a remarkable feat. (See Figure 3–5.)[51]

Since 1984, however, grain yields have changed little. One reason is undoubtedly the depressed level of farm prices during this period, which has discouraged both short-term investment in inputs, such as fertilizer, and longer-term investments in land improvement. The monsoon failure in India in 1987 and the droughts in North America and China in 1988 also lowered the global average yield. If grain prices increase, however, yields should resume their long-term rise.[52]



Source: U.S. Dept. of Agriculture

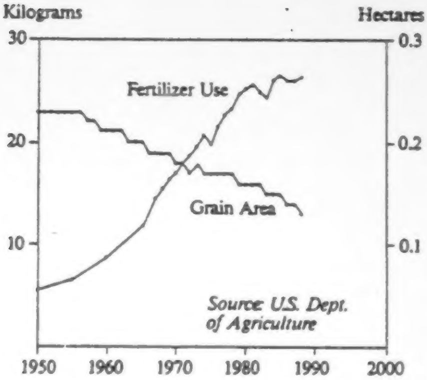
Figure 3-5. World Grain Yield Per Hectare, 1950–88

By far the most important source of rising grain yields in recent decades has been the growth in fertilizer use. From 1950 through 1984, world fertilizer use moved higher each year, with only occasional interruption. It increased during this time from 14 million to 125 million tons, a gain of more than 11 percent per year. Between 1984 and 1988, however, usage went from 125 million to 135 million tons, an annual rise of less than 2 percent. The trend has become somewhat erratic as agricultural commodity prices have weakened, Third World debt has soared, the yield response to fertilizer use has diminished, and many financially pressed governments have reduced fertilizer subsidies.[53]

In per capita terms, world fertilizer use quintupled between 1950 and 1984, going from 5 kilograms to 26 and offsetting a one-third decline in grain area per person. (See Figure 3–6.) As land becomes scarce, farmers rely more on additional fertilizer to expand output, in effect substituting energy in the form of fertilizer for land in the production process.[54]

The bulk of this impressive increase in world fertilizer use during the fifties and most of the sixties occurred in the industrial world. But the practice spread in Asia as Green Revolution varieties of wheat and rice were widely introduced. In China, chemical fertilizers were not widely used until 1960, when it became clear that organic fertilizers were not going to be able to produce enough food for the country's growing population. Usage more than doubled between 1976 and 1981—the steepest increase ever in a major food-producing country—although organic fertilizer continues to be a major source of plant nutrients in China.[55]

Some sense of the potential for raising land productivity worldwide can be



Source: U.S. Dept. of Agriculture

Figure 3-6. World Fertilizer Use and Grain Area Per Capita, 1950-88

gleaned from looking at yield trends for wheat, rice, and corn in countries with the highest yield levels—for example, rice in Japan, corn in the United States, and wheat in the United Kingdom. In 1950, crop yields in these countries were essentially the same, at about 2.25 tons per hectare. Over time, the Japanese rice yield increased slowly, reaching 4 tons per hectare in the mid-seventies. Since then, it has increased relatively little, even though the government support price is far above the world market price.[56]

A similar trend exists in other high-technology rice-producing countries, such as South Korea, Taiwan, and Italy. In each case, once rice yields pass 4 tons per hectare, they rise quite slowly or even level off, suggesting that dramatically surpassing this level may await new technological advances. Agricultural economists Duane Chapman and Randy Barker of Cornell point out that "the genetic yield potential of rice has not increased significantly since the release of the high yielding varieties in 1966." In effect, the highest yielding rice varieties available to Asian farmers in 1989 were released 23 years ago.[57]

With both corn and wheat, yields have gone much higher. Corn yields in the United States, for example, have exceeded 7 tons per hectare (112 bushels per acre) in good crop years. Likewise, wheat in the United Kingdom has ranged between 6 and 7 or more tons per hectare in recent years.[58]

At this point, no one knows how far yields can profitably be raised. Eventually, growth in yield per hectare, like the growth of any other biological process in a finite environment, will conform to the S-shaped growth curve. What is not clear is how close output in the higher-yield countries is to the upper inflection point on this curve, where the rise will slow markedly and begin to level off.

The systematic application of science to agriculture and the increasing investment of energy in agricultural inputs and processes has permitted a regular yearly increase in yields for more than a generation, making it difficult to imagine a situation where yields will not continue their steady rise. Nonetheless, some analysts are becoming concerned about the potential for indefinitely raising yields, a concern heightened by the limited potential for finding new cropland.

Robert Herdt, senior economist at the Rockefeller Foundation, anticipates a slowdown in grain production growth in the developing countries. He observes that "in the next five to ten years there is little potential for further rapid spread of existing semi-dwarf varieties that provided the breakthrough in developing-country wheat and rice production in the mid-1960s. Likewise, it appears that there is little scope for increasing the rates of fertilizer [application] on those varieties much above their mid-1980s levels."[59]

In some farming communities crop yields on the best farms now approach those on experimental plots. It is unrealistic, however, to expect yields on farms actually to reach these high levels. Such plots are used to determine the maximum physical response to an input, such as fertilizer. Farmers, on the other hand, are concerned with the maximum profit response. Scientists working on experimental plots can increase fertilizer use until there is no more response. Farmers must stop when the value of the additional yield no longer covers the cost of the extra fertilizer.

Similarly, scientists on experimental plots can plant during the period that will produce maximum yields. Farmers, who must deal with such real-world constraints as multiple-cropping and the demands on their time imposed by other crops, often cannot plant during this narrow time window.

Rising grain yield per hectare must eventually give way to physical constraints. With cereal yields, the ultimate limit may be photosynthetic efficiency. Where the best farmers supply all the nutrients and water that advanced varieties can use, cereal yields may now be approaching this limit.

Biotechnology is a timely addition to the scientist's tool kit, but it does not promise dramatic production gains.

Evidence that photosynthetic constraints may be emerging can be seen in the diminishing returns on fertilizer use. Whereas 20 years ago the application of each additional ton of fertilizer in the U.S. Corn Belt added 15 to 20 tons to the world grain harvest, today it may add only 5 to 10 tons. In analyzing recent agricultural trends in Indonesia, Chapman and Barker note that "while one kilogram of fertilizer nutrients probably led to a yield increase of 10 kilograms of unmilled rice in 1972, this ratio has fallen to about one to five at present." This, combined with depressed farm prices, helps explain why growth in world fertilizer use has slowed in recent years, and why it has actually declined in some countries, including the United States.[60]

Hybrid wheats and rices have been available for many years but, except for hybrid rice in China, their widespread use awaits far higher grain prices. And since yields of the more productive wheat and rice strains now in use are much closer to the photosynthetic limit than were those of corn when hybrids were introduced 50 years ago, the potential for raising output is comparatively modest.

Other possibilities for boosting yield lie in breeding cereals more tolerant of salt, drought, and heat. In a world growing warmer, gains from this source will loom far larger than they do today.

Contrary to popular belief, biotechnology is not an agricultural panacea that will end hunger. For instance, the widely discussed development of nitrogen-fixing cereals, which biotechnological techniques could facilitate, would reduce the need for fertilizer but would also likely lower yields, since some of the plant's metabolic energy is diverted to fixing nitrogen rather than producing seed. Biotechnology is a timely addition to the scientist's tool kit, one that will speed the pace and the potential return on investment in agricultural research, but it does not promise dramatic production gains. The contribution of this research tool, like all the others that scientists use, is ultimately constrained by the limits of photosynthetic efficiency.

Unfortunately, no identifiable technologies are waiting in the wings that will lead to the quantum jumps in world food output such as those associated with the spread of hybrid corn, the ninefold increase in fertilizer use between 1950 and 1984, the near-tripling of irrigated area during the same period, or the relatively recent spread of the high-yielding dwarf wheats and rices in developing countries. The contribution of these technologies is diminishing in some situations and no major new technologies are emerging to take their place.

Although countries where yields are already quite high are finding it difficult to maintain a rapid rise, those where yields are low can tap existing technologies to boost their output. For example, Japan may not be much more successful in raising rice yields in the nineties than it has been in the late eighties, but India, where rice yields are less than half those of Japan, still has a large unrealized potential.[61]

FOOD SECURITY TRENDS

The two most useful global indicators of food security are per capita grain production and carryover stocks of grain—the amount in the bin when the new harvest begins. The trend in per capita production gives a sense of whether overall food availability is improving or deteriorating. Changes in carryover stocks indicate whether production is exceeding consumption or falling short of it.

World grain production increased substantially faster than population from 1950 through 1984, boosting per capita output from 246 to 345 kilograms. This 40-percent increase led to impressive improvement in diets in many countries, boosting consumption of livestock products. Per capita output declined slightly in 1985 and 1986 before dropping sharply in 1987 and again in 1988. Between 1984 and 1988, grain production per person fell from an all-time high of 345 kilograms to 296 kilograms.[62]

The decline in total grain production in 1988—largely the result of the droughts in North America and China—completed the largest two-year drop on record. The accompanying 14-percent fall in per capita production since 1984 brought this indicator back to the levels of the mid-seventies. Record grain reserves permitted a drawdown of stocks to offset most of the decline, limiting the drop in consumption per person to 3 percent.[63]

This look at global changes in per capita production, however, obscures wide differences in regional trends. The principal determinant of whether food production per person is rising or declining in this case is the differential rate of population growth. For example, while per capita production in Western Europe was climbing rapidly, that in Africa peaked in 1967 and has declined some 27 percent since then. These two regions illustrate the extremes.[64]

Unfortunately, Latin America has joined Africa during the eighties as the second region to experience a decline in food production per person. Since 1981, the year before the debt crisis began, the region's output per person has fallen by roughly one tenth, expanding the region's grain deficit.[65]

As total grain production has declined during the last two years, so too have stocks. World carryover stocks reached an all-time high at the beginning of 1987 of 459 million tons, enough to feed the world for 101 days. During 1987, stocks dropped to 402 million tons. In 1988, world consumption is likely to exceed production by a staggering 152 million tons. (See Table 3-3.) Unless the mid-year USDA world grain consumption estimate of 1,673 million tons is reduced by rising prices, year-end stocks are expected to fall to roughly 250 million tons. This amounts to 54 days of consumption, less than the 57-day supply at

Table 3-3. World Grain Production, Use, and Carryover Stocks, 1961–88

Year	Production	Consumption	Carryover Stocks: Quantity	Carryover Stocks: Consumption Equivalent
		(million metric tons)		(days)
1961	813	835	185	81
1965	917	952	159	61
1970	1,096	1,130	198	64
1971	1,194	1,169	223	70
1972	1,155	1,192	186	57
1973	1,271	1,259	198	57
1974	1,219	1,213	203	61
1975	1,250	1,229	221	66
1976	1,363	1,303	281	79
1977	1,337	1,338	279	76
1978	1,467	1,418	328	84
1979	1,428	1,440	315	80
1980	1,447	1,475	286	71
1981	1,497	1,476	307	76
1982	1,548	1,500	355	86
1983	1,485	1,537	303	72
1984	1,645	1,585	363	84
1985	1,661	1,594	430	98
1986	1,682	1,653	459	101
1987	1,597	1,653	402	89
1988	1,521	1,673	250	54

SOURCES: 1961–87, U.S. Department of Agriculture, Foreign Agricultural Service, *World Grain Situation and Outlook*, Washington, D.C., July 1988; 1988, Worldwatch Institute.

the end of 1972, when world grain prices doubled.[66]

At this low level, carryover stocks amount to little more than "pipeline" supplies. Substantial quantities of grain are required to keep the trucks and barges between producer and consumer filled. The supply lines from the United States, which holds a disproportionately large share of global carryover stocks in order to assure regular supplies to its customers, often stretch halfway around the world.

In addition to its carryover stocks, the world has a second line of defense against food shortages—the cropland idled under U.S. commodity programs. In 1988, some 20 million hectares (50 million acres) were idled under farm programs designed to maintain price stability. (See Table 3–4.) Virtually all this land can be returned to production within a year if the USDA decides it is needed.

Amounting to roughly 2 percent of the world cropland area, this reserve can help boost production now that stocks are depleted. Given the precariously low level of carryover stocks, prudence argues for bringing this land back into

Table 3-4. United States: Cropland Idled Under Commodity Programs, 1965–88

Year	Land Area (million hectares)
1965	17.4
1966	19.3
1967	10.2
1968	14.5
1969	20.3
1970	21.5
1971	13.7
1972	23.8
1973	6.8
1974	0.0
1975	0.0
1976	0.0
1977	0.0
1978	7.4
1979	5.3
1980	0.0
1981	0.0
1982	4.5
1983	31.5
1984	10.9
1985	12.5
1986	17.5
1987	21.7
1988	20.1

SOURCE: Brad Karmen, U.S. Department of Agriculture, private communication, June 24, 1988.

production in 1989. However, the 12 million hectares of highly erodible cropland that has been planted to grass or trees since early 1986 under the Conservation Reserve Program should not be disturbed.[67]

The overwhelming dependence on North America, where agricultural output in both the United States and Canada is affected by the same climatic cycle, introduces a special dimension of food insecurity. A drought in the United States is invariably accompanied by one in Canada. In 1988, when the U.S. grain harvest was down 29 percent, that of Canada was reduced by 33 percent. With the United States and Canada controlling a larger share of grain exports than *the Middle East does of oil, this is an* issue of concern to food-importing countries everywhere.[68]

The risk of such overwhelming dependence on one region is obvious. During the eighties, North American grain exports have averaged around 110 million tons per year. Even at this level, some U.S. cropland has been idled during most of the decade.

As stocks have dropped, higher prices and scarce supplies increasingly pose a serious threat to those food-importing countries with low incomes. When carryover stocks hit 57 days at the end of 1972, the United States returned its idled cropland to use. Four years passed, however, before world grain reserves were rebuilt and food-importing countries could again breathe easily.

Thus, the devastated grain crop in North America in 1988 is sobering news for the more than 100 countries that depend on imports from the North American breadbasket. For the poorer food-deficit countries, many with external debts that are already unmanageable, maintaining needed imports in the face of sharp price rises may not be possible. For people living in these countries, the road to the next harvest could be a long one.

In the drought-stricken year of 1988, the U.S. grain harvest fell below domestic consumption, probably for the first time in history. (See Table 3–5.) With a harvest of 196 million tons and an estimated consumption of 206 million tons, there was no surplus for export from the 1988 crop. Export demands until the 1989 harvest begins are being

Table 3-5. United States: Grain Production, Consumption, and Exportable Surplus by Crop Year, 1980–88

Year	Production	Consumption	Exportable Surplus from Current Crop[1]
		(million metric tons)	
1980	268	171	+ 97
1981	328	179	+ 149
1982	331	194	+ 137
1983	206	182	+ 24
1984	313	197	+ 116
1985	345	201	+ 144
1986	314	217	+ 97
1987	277	215	+ 62
1988	196	206	− 10

[1] Does not include carryover stocks.

SOURCE: USDA, Foreign Agricultural Service, *World Grain Situation and Outlook*, Washington, D.C., October and November 1988.

met almost entirely by drawing down stocks. If those had not been available, the 10-million-ton shortfall would also have forced a reduction in domestic consumption, or the importation of grain if it were available.

What will happen if there is a severe drought in 1989? Historically, the odds against severe back-to-back droughts have been rather high. But with global warming now apparently under way, the frequency of hot, dry summers is increasing. In the event of even a moderate drought in North America, world food prices would soar. A severe drought would cause a global food emergency.

In sum, overall food security is being threatened by two trends. One is the loss of momentum in the growth in output, a loss that is particularly noticeable in major developing countries, such as China, India, Indonesia, and Mexico. The second trend is the warming of the planet. The areas that are likely to experience higher temperatures and lower rainfall include some of the earth's key food-producing regions, such as mid-continental North America. The world's farmers—already struggling to keep up with the record year-to-year growth in population—are facing the nineties with a great deal of uncertainty about how quickly the warming will progress and how it will affect their production.

Meeting adequate food needs during the nineties and beyond will require far more of the attention of political leaders, particularly those in the Third World, than ever before. (See Chapter 10.) Unless national governments are prepared to wage the war against hunger on a much broader front, it may not be possible to arrest the decline in per capita food production that is now undermining the future of so many people.

A LOSS OF FOOD SECURITY

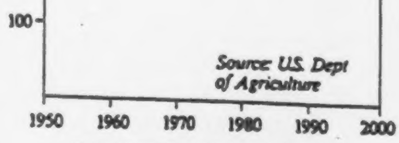
As the eighties draw to a close, climate change is being added to an already long list of environmental stresses and resource scarcities that are undermining global food security. Soil erosion, desertification, the salting of irrigated lands, and a scarcity of new cropland and fresh water are combining to lower the growth in food output below that of population in dozens of developing countries. Partly as a result, the world now has far more hungry people than it did when the eighties began.[37]

A dramatic 2.6-fold increase in grain production between 1950 and 1984 raised per capita consumption by nearly 40 percent. But since then growth has stopped. In each of the past two years, world grain production has fallen sharply, marking the first steep back-to-back annual declines on record. A monsoon failure in India in 1987 and drought-reduced harvests in North America and China in 1988 explain only part of the reduction. In several populous countries, including China, India, Indonesia, and Mexico, little or no progress has been made in expanding grain production since 1984.[38]

Continuing rapid growth of world population during the last few years combined with the reduced harvests has led to a record fall in per capita output of grain, the food source that accounts for half of world caloric intake when consumed directly and a sizable part of the remainder when consumed indirectly as meat, milk, and eggs. Between 1986 and 1988, production per person fell 14 percent, dropping back to the level of 1970. (See Figure 1-3.) Roughly 11 percent was offset by using carryover stocks of grain; the remaining 3 percent translates into reduced food intake, largely because of higher world grain prices.[39]

This reversal in humanity's agricultural fortunes has occurred rather abruptly. For those accustomed to reading as recently as early 1988 of "a world awash in grain," the latest downturn in grain output may come as a surprise. Although not widely recognized at the time, the impressive growth in world production following the doubling of world grain prices in 1973 was achieved in part by plowing highly erodible land, and in part by drawing down water tables through overpumping for irrigation.

Farmers can overplow and overpump with impressive results in the short run, but for many the short run is drawing to a close. The result is a worldwide retrenchment in cultivated area and a dramatic slowdown in the spread of irrigation. As highly erodible cropland brought under the plow during the agri-



Source: US Dept of Agriculture

Figure 1-3. World Grain Production Per Capita, 1950-88

cultural boom years of the seventies is taken out of cultivation, and as falling water tables in key food-producing countries force a reduction in irrigated area, the growth in world food output is slowing.[40]

In each of the past two years, world grain production has fallen sharply.

Evidence that environmental degradation in some regions is altering the food prospect and, in turn, the human prospect is unmistakable. In Africa, a deteriorating agricultural resource base, record population growth, and economic mismanagement lowered grain output per person throughout the seventies. During the eighties, mounting external debt reduced capital available for investment in agriculture, exacerbating the decline.[41]

The social effects of agricultural adversity are now becoming highly visible throughout the continent. In mid-1988, the World Bank reported that "both the proportion and the total number of Africans with deficient diets have climbed and will continue to rise unless special action is taken." The Bank went on to say that "barely a quarter of Africans are living in countries where food consumption was increasing in the 1980s, down considerably from about two-thirds in the 1970s."[42]

In Africa, the number of "food insecure" people, defined by the Bank as those not having enough food for normal health and physical activity, now totals over 100 million. Some 14.7 million Ethiopians, one third of the country, are undernourished. Nigeria is close behind, with 13.7 million undernourished people. The countries with 40 percent or more of their populations suffering from chronic food insecurity are Chad, Mozambique, Somalia, and Uganda. (See Table 1-1.) The Bank summarized its findings by noting that "Africa's food situation is not only serious, it is deteriorating."[43]

The island of Madagascar, with a population of 11 million expanding by 3 percent per year, reveals in some detail how population growth and environmental deterioration are affecting people. As with the rest of Africa, per capita grain production peaked in 1967 and declined gradually until 1983, when the fall accelerated. Since then average grain consumption has fallen by nearly one fifth, pushing food intake below the survival level for many. Infant mortality, the most sensitive indicator of nutritional stress, rose from 75 to 133 per thousand between 1975 and 1985. Short of a mira-

Table 1-1. Food Insecurity in Selected African Countries, 1986

Country	Number of People	Share of Population
	(million)	(percent)
Ethiopia	14.7	34
Nigeria	13.7	13
Zaire	12.0	38
Tanzania	6.6	29
Kenya	6.2	29
Uganda	6.1	40
Mozambique	5.9	42
Algeria	4.1	18
Ghana	4.1	31
Sudan	3.4	15
Zambia	2.7	39
Mali	2.5	33
Chad	2.4	47
Morocco	2.4	11
Somalia	2.3	42

SOURCE: World Bank, *Report of the Task Force on Food Security in Africa* (Washington, D.C.: 1988); World Bank, *World Development Report 1988* (New York: Oxford University Press, 1988).

cle, the future of this country, with a birth rate among the world's highest and a rate of topsoil loss greater even than that of Ethiopia, is not bright.[44]

This deterioration is not limited to Africa. In Latin America, which exported more grain than North America did a mere half-century ago, per capita grain production has fallen 7 percent since reaching an all-time high in 1981. In its 1988 report "The Global State of Hunger and Malnutrition," the U.N.'s World Food Council reports that the share of malnourished preschoolers in Peru increased from 42 percent to 68 percent between 1980 and 1983. Infant deaths have risen in Brazil during the eighties. If recent trends in population growth, land degradation, and growth in external debt continue, Latin America's decline in food production per person will almost certainly continue into the nineties, increasing the number of hungry, malnourished people. The Council summarized its worldwide findings by noting that "earlier progress in fighting hunger, malnutrition and poverty has come to a halt or is being reversed in many parts of the world."[45]

When domestic food production is inadequate, the ability of countries to import becomes the key to food sufficiency. During the late eighties, low-income grain-deficit countries must contend not only with an increase in grain prices, but also in many cases with unmanageable external debt, which severely limits their expenditures on food imports. The World Bank nutrition survey of Africa just cited was based on data through 1986; since then, conditions have deteriorated further as world grain prices have climbed.[46]

The effect of higher grain prices on consumers is much greater in developing countries than in industrial ones. In the United States, for example, a $1 loaf of bread contains roughly 5¢ worth of wheat. If the price of wheat doubles, the price of the loaf would increase only to $1.05. In developing countries, however, where wheat is purchased in the market and ground into flour at home, a doubling of world grain prices translates into a doubling of prices to consumers. For those who already spend most of their income on food, such a rise can drive consumption below the survival level.[47]

For debt-ridden, food-deficit, low-income countries, higher world prices of wheat, rice, and corn mean lower consumption and more hunger. (See Table 1-2.) Higher corn prices will affect most directly corn-consuming countries in East Africa and Latin America. The rising price of rice will reduce caloric intake among the low-income populations of Asia, where 90 percent of the world's rice is consumed. The 1988 jump in the price of wheat, the principal grain used for food aid, will reduce the amount available from international development agencies.[48]

Already faced with a deteriorating food situation, the world is now confronted with climate change, an additional threat to food security. The

Table 1-2. World Grain Prices, July 1988, Compared With July 1987

Grain	July 1987	July 1988	Change
	(current dollars)		(percent)
Wheat (price per bushel)	2.85	4.07	+43
Rice (price per ton)	212	305	+44
Corn (price per bushel)	1.94	3.22	+66

SOURCE: International Monetary Fund, *International Financial Statistics* (Washington, D.C.: various months).

drought-damaged U.S. grain harvest in 1988, which fell below consumption for the first time in recent history, illustrates how global warming may affect agriculture over the longer term in the United States and elsewhere. With normal weather, the United States typically harvests more than 300 million tons of grain; Americans consume roughly 200 million tons and the rest is exported. Because this year's drought eliminated the share of harvest normally sold overseas, exports during the 1988–89 trade year will come entirely from reserves.[49]

As noted earlier, climate change will not affect all countries in the same way. The projected rise of 1.5–4.5 degrees Celsius (3–8 degrees Fahrenheit) is a global average, but temperatures are expected to increase much more in the middle and higher latitudes and more over land than over the oceans. They are projected to change little near the equator, while gains in the higher latitudes could easily be twice the anticipated global average. This uneven distribution will affect world agriculture disproportionately, since most food is produced in the middle and higher latitudes of the northern hemisphere.[50]

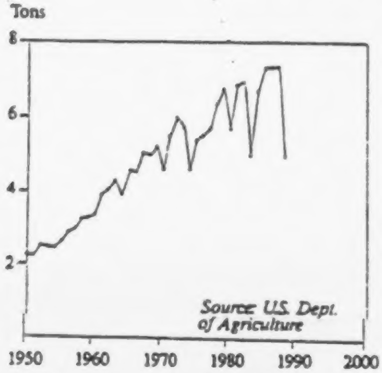
Though they remain sketchy, meteorological models suggest that two of the world's major food-producing regions—the North American agricultural heartland and a large area of central Asia—are likely to experience a decline in soil moisture during the summer growing season as a result of higher temperatures and increased evaporation. If the warming progresses as the models indicate, some of the land in the U.S. western Great Plains that now produces wheat would revert to rangeland. The western Corn Belt would become semiarid, with wheat or other drought-tolerant grains that yield 40 bushels per acre replacing corn that yields over 100 bushels.[51]

On the plus side, as temperatures increase the winter wheat belt might migrate northward, allowing winter strains that yield 40 bushels per acre to replace spring varieties yielding 30 bushels. A longer growing season would also permit a northward extension of spring wheat production into areas such as Canada's Alberta province, thus increasing that nation's cultivated area. On balance, though, higher temperatures and increased summer dryness will reduce the North American grain harvest, largely because of their negative impact on the all-important corn crop.

Drought, which afflicted most of the United States during the past summer, is essentially defined as dryness. For farmers, drought conditions can result from lower than normal rainfall, higher than normal temperatures, or both. When higher temperatures accompany below-normal rainfall, as they did during the summer of 1988, crop yields can fall precipitously. Extreme heat can also interfere with the pollination of crops. Corn pollination can easily be impaired by uncommonly high temperatures during the 10-day period when fertilization occurs, usually in July.[52]

A study from the National Center for Atmospheric Research in Boulder, Colorado, suggests that a rise in average temperatures will also increase the probability of extreme short-term heat waves. If these occur at critical times—such as the corn pollination period—they can have a much greater effect on crop yields than the relatively modest average temperature increase of a few degrees might indicate.[53]

This vulnerability of corn, which accounts for two thirds of the U.S. grain harvest and one eighth of the world's, can cause wide year-to-year swings in the world grain crop. An examination of U.S. corn yields since 1950 shows five sharply reduced harvests over the last 38 years. (See Figure 1–4.) The only pronounced drops before the eighties came



Source: U.S. Dept. of Agriculture

Figure 1-4. U.S. Corn Yield Per Hectare, 1950-88

in 1970, from an outbreak of corn blight, and in 1974, when a wet spring and late planting combined with an early frost to destroy a part of the crop before it matured.[54]

Three harvests since 1950 have been sharply reduced by drought, all in the eighties. Each drop has been worse than the last. Compared with the preceding year, the 1980 corn yield per hectare was down by 17 percent, that in 1983 was down by 28 percent, and that in 1988 by a staggering 34 percent.[55]

These three reduced harvests each occurred during one of the five warmest years globally of the last century. There is no way to conclusively link the drought-depressed U.S. harvests with the global warming, since annual weather variability is so much greater than the rise in average global temperatures measured during the eighties.[56]

Among other things, the prospect of climate change increases uncertainty over future harvests, making decisions more complicated for farmers and policymakers alike. For example, the 1989 U.S. grain crop could be a binbuster, the largest ever harvested. With a normal harvest elsewhere in the world, this would permit at least a modest rebuilding of depleted grain reserves.

Judging by the historical record, the odds are against severe back-to-back droughts, but with the warming now apparently under way, hot dry summers will become more frequent. In the event of another disastrous drought, U.S. grain exports would drop dramatically. The world would face a food emergency for which there is no precedent in the decades since North America emerged as its breadbasket. There would be a desperate effort to corner available supplies as world grain prices soared to record levels. In such a situation, preventing starvation among the world's poor would require affluent countries to reduce the amount of grain fed to livestock.

Asian and African countries, in particular, would find it impossible to feed their people without North American grain. Many of the world's major cities—Leningrad, Cairo, Lagos, Caracas, and Tokyo, for example—depend largely on grain from the United States and Canada. In an integrated world food economy, all countries suffer the consequences of poor harvests.[57]

All available evidence indicates that the ranks of the hungry are expanding during the late eighties, reversing the trend of recent decades. Uncertainties and stresses from a changing climate are now being overlaid upon an already tightening food situation. In the absence of a major commitment by governments to slow population growth and strengthen agriculture, food insecurity and the social instability associated with it will preoccupy the political leaders of many countries during the nineties.

MEETING FUTURE FOOD NEEDS

In many ways, the nineties will be unlike any decade that the world's farmers have ever faced. There will be little opportunity for expanding cultivated area; irrigated area, while growing slowly worldwide, is declining in some key countries. For the world's more advanced farmers, there are few new technologies to draw upon. In many countries, returns on the use of additional fertilizer—which has been the driving force behind the worldwide expansion of food output over the past four decades—are diminishing. And, finally, the prospect of global warming now hangs over the future of agriculture.[33]

On the demand side, the annual increment in world population is projected to climb to record highs in the years immediately ahead. The 86 million added in 1988 are expected to joined by at least 90 million annually during the early nineties. And most of the added millions will live in countries where nutrition is already inadequate and, in many cases, deteriorating.[34]

Meeting future food needs is a far more complex undertaking today than it was 20 years ago. During the sixties, outlining a strategy for expanding food output was relatively simple in most countries. The key was assuring farmers a price for their harvest that would make investments in fertilizer, irrigation, and improved varieties profitable. In many developing countries this required reversing food price policies that had traditionally catered to urban interests, substituting food price supports for food price ceilings. When governments adopted these price support policies and ensured that yield-raising inputs were available, farmers could often double or triple the productivity of their land.

Restoring the rapid growth in world

food output that existed from 1950 to 1984 will not be easy. In some countries and regions, massive gains in output are still possible. In others, the potential for large jumps in the near future is limited. Achieving a satisfactory balance between food and people is becoming more difficult and may not be possible without raising the efficiency of feedgrain use and dramatically lowering birth rates in countries where population is still growing rapidly.

Among the areas where massive increases in output are unlikely, because yields are already high and response to the use of additional fertilizer is low, are Japan, China, Western Europe, and North America. Some regions, such as the semiarid West African Sahel, have no technologies available that will sharply boost output.[35]

India, Argentina, Brazil, and the Soviet Union, on the other hand, all have a large potential to raise yields. In India, where grain yield per hectare is less than half that in China, a combination of incentive prices, investment in irrigation, and the use of more fertilizer should greatly boost output in the years ahead. At present, India's farmers use less than half as much fertilizer per hectare as do their Chinese and U.S. counterparts.[36]

Policy adjustments could also spur output in Argentina, which still taxes food exports, thus discouraging farmers by reducing the prices they receive to levels well below those of the world market.[37]

Brazil, too, has a large unrealized potential, one that may reside as much in land reform as in expanding the cultivated area. In few countries is landownership as concentrated as in Brazil, where 70 percent of rural households are essentially landless. World Bank studies in several countries demonstrate that farmers with small holdings produce more per hectare than those with large holdings. In part this is because small farmers, using family labor, can boost output by continuing to use more labor per hectare even though the value of the resultant additional output is less than the prevailing wage. Large landowners who rely on hired labor cannot afford to do this.[38]

In the Soviet Union, reforms that strengthen the link between effort and reward for those working the land could substantially increase the productivity of agriculture. A plan to lease land to individual farmers for up to 50 years, announced in Moscow in August 1988, could measurably lift farm output, perhaps reducing the need to import grain.[39]

For some countries, many of which are in Africa, local rainfall is too low and irrigation water too scarce to permit the extensive use of fertilizer. Fortunately, alternatives exist for many of these countries, which may never develop a fossil-fuel-based agriculture. While these will not lead to the dramatic gains in yield of the Green Revolution technologies, they can boost production markedly among subsistence farmers, where the need is greatest. In many tropical and subtropical regions, agroforestry (the incorporation of trees and field crops into a single farming system) is proving to be highly productive. (See Chapter 2.) The trees can provide food, forage, fuel, organic matter in the form of leaf drop, and, if they are nitrogen-fixing, nitrogen for the crops grown in the immediate vicinity.[40]

One type of agroforestry involves a technique known as alley cropping, in which strips of fast-growing leguminous trees are alternated with rows of food crops, making it possible to sustainably cultivate some soils that otherwise would quickly deteriorate once plowed. The leguminous trees provide nitrogen and, through their leaf drop, organic material to nourish the soil; the alternate strips also control soil erosion.[41]

Where labor is abundant relative to

land, labor-intensive agricultural techniques such as multiple cropping (growing more than one crop per year) and intercropping (simultaneously planting more than one crop on a piece of land) can make a big difference. So can the composting of organic wastes, including straw, livestock manure, and leaves. In densely populated parts of Africa and Asia, the stall feeding of livestock, also labor-intensive, both helps control land degradation from random grazing and concentrates livestock manure, making composting easier.[42]

As population pressures build, land can be farmed more intensively using such techniques as biointensive gardening. This has figured prominently in efforts to expand production of vegetables to supplement cereals and tubers on the Philippine island of Negros. The technique, involving hand-tillage of the seedbed to one foot or more in depth, relies on local materials to improve and maintain soil fertility. Among the local inputs used in these highly productive plots are compost manure, wood ash, bonemeal, leucaena leaves (from a fast-growing nitrogen-fixing tree), and crushed eggshells. Like the high-yielding rices that originated in the Philippines, this technology has a potentially broad application in other countries.[43]

With cropland becoming scarce, future food security depends on safeguarding it from conversion to nonfarm uses and from erosion.

One of the keys to raising output on a sustainable basis is protecting the resource base. With cropland becoming scarce, future food security depends on safeguarding it both from conversion to nonfarm uses and from the erosion that reduces its inherent productivity. Nearly a decade ago, U.S. Assistant Secretary of Agriculture Rupert Cutler observed that "asphalt is the land's last crop." Once productive cropland is lost to suburban development, shopping malls, or roads, it is difficult to restore it to food production.[44]

A few countries, such as Japan, have carefully crafted programs designed to protect cropland. In 1968, Japan adopted a comprehensive zoning plan that put all land in one of three categories—industrial, agricultural, or other—and made it illegal to build on cropland. Faced with acute land pressures, Japan confronted the issue early and in doing so established an approach to cropland preservation that is simple, effective, and easily adapted to conditions in other countries.[45]

National success stories in the effort to conserve topsoil are few. Among the major food-producing countries, the United States is the only one systematically reducing excessive soil erosion. Its Conservation Reserve Program both encourages conversion of highly erodible cropland to grassland or woodland and penalizes farmers who do not manage their soil responsibly by denying them the benefits from farm programs. In 1987, the program's second year, U.S. soil losses were reduced by 460 million tons, the greatest year-to-year reduction on record for any country.[46]

In a world where fresh water is becoming more scarce, future growth in irrigation may depend on greater investments in the efficiency of water use. Stopping leakage from irrigation canals and ditches and abandoning the use of wasteful irrigation technologies present obvious opportunities. Israel, with its underground drip system and other advanced irrigation technologies, has expanded its irrigated area by using available water supplies more carefully. In many countries, the key to such gains is the elimination of water subsidies, which actually encourage the inefficient use of irrigation water.[47]

Early international agricultural research efforts concentrated heavily on raising yields of wheat and rice, the world's principal staple foods. In recent years, the Consultative Group on International Agricultural Research—a network of 13 ably staffed agricultural research centers, all but one in the Third World—has shifted its attention to raising output of such minor staples as millet, chickpeas, and cassava, crops produced by low-income, subsistence farmers. Although a far more demanding undertaking, this research effort is responsive to the needs of a large group of farmers, many of whom do not have access to fertilizer.[48]

In a warmer world, where fresh water is becoming scarce, scientists can help push back the physical frontiers of cropping by developing varieties that are more drought-resistant, salt-tolerant, and early-maturing. The payoff on the first two could be particularly high. It is in this area that biotechnology may be helpful in speeding up the plant breeding process.

Events of the last two years suggest that the time also has come to rethink international grain reserve policies. Two or more consecutive drought-reduced harvests could easily wipe out a normal level of reserves. Had there not been a record amount of grain in storage at the beginning of the 1987 crop year, back-to-back declines in the world grain harvests since then would by now have created a world food emergency. As it is, world grain prices in late 1988 had risen by half since late 1987.[49]

Ensuring an adequate level of grain stocks requires taking into account not only year-to-year variations in the weather but the uncertain effects of rising temperatures as well. Global warming will deepen the uncertainty surrounding each year's crop and probably increase the frequency of reduced harvests. (See Chapter 1.) For example, the three drought-reduced U.S. harvests in the eighties could increase to four or five in the nineties and even more thereafter. With much of the 20 million hectares of cropland idled under U.S. supply management programs scheduled to return to production in 1989, the need to establish a more formal set of guidelines for managing world grain reserves will become increasingly urgent.

If world food supplies tighten in the years ahead, the distribution of available supplies will become even more important than when the world was plagued with surpluses. High on the list of questions will be how much of the world's grain supply can be fed to livestock. At present, roughly 500 million tons of an annual harvest of usually 1.6 billion tons is consumed this way.[50]

If the U.S. cropland now set aside under the supply management programs were returned to production, the only remaining major food reserve to fall back on if carryover stocks of grain are depleted would be the grain consumed by livestock. When grain prices rise sharply, as they did in 1973, higher meat prices and the resulting drop in consumer demand force a reduction in the amount of grain fed to livestock. Tragically, by the time grain prices actually affect affluent consumers' consumption of meat, milk, and eggs, the world's poorest may not be getting enough grain to survive.[51]

The relative efficiency of converting grain to various types of animal protein also affects the world grain supply-and-demand balance. The least efficient livestock product is beef produced in feedlots, where it takes roughly seven pounds of grain to produce a pound of meat. The grain used in producing a quarter-pound hamburger could feed a person in a low-income country for two days. The production of broilers, much more efficient than beef, requires roughly two pounds of grain per pound of meat. Thus, shifts from beef to poultry, already under way in some societies for health reasons, help stretch the world supply of grain.[52]

Shifts from beef to poultry, under way in some societies for health reasons, help stretch the world supply of grain.

Perhaps the principal conclusion in this year's analysis of the world food prospect is that future food security may lie more in the hands of family planners than farmers. Agricultural policymakers and farmers acting alone may not be able to ensure adequate food supplies in the years ahead. What is needed is a major assist of the sort that China's family planning ministry has provided that country's farmers over the last two decades, a lift that, when combined with economic reforms in agriculture, helped raise food output per person by nearly half between 1976 and 1984.[53]

STABILIZING POPULATION

At the annual meeting in Berlin in September 1988, World Bank President Barber Conable urged developing countries to "renew and expand efforts to limit population growth," saying that rapid population increase was contributing to persistent and widespread poverty, which he described as a "moral outrage." Conable's comments reflected growing frustration within the Bank over the inability of many of its member countries to raise living standards. In most countries in Africa, and several in Latin America, average food consumption is falling and living conditions are deteriorating. In many of these countries, the restoration of economic and social progress now depends on quickly reducing population growth.[54]

Population stabilization is the only acceptable goal in a world where growth in human numbers is leading to a life-threatening deterioration of environmental systems. In 13 countries, home to some 266 million people, birth rates have already fallen to the point where births and deaths are in balance. Except for Czechoslovakia, East Germany, and Hungary, all are in Western Europe. They range from tiny Luxembourg to three of the four largest countries in Western Europe—Italy, the United Kingdom, and West Germany.[55]

Balancing birth and death rates was not an explicit goal in any of these countries. Fertility declined as economic and social conditions improved. As incomes rose and employment opportunities for women expanded, couples chose to have fewer children. The wide availability of family planning services and liberal abortion laws provided the means for them to do so.

The contrasting prospects of these countries and those where populations are projected to double, triple, or quadruple (see Table 10–2) is alarming. The experience of recent years indicates that rapid population growth and social progress are not compatible over the long term. Countries either make the shift to smaller families, as China has done, or their life-support systems begin to break down, as is occurring in many African countries. Given the conditions of these systems and the trends in per capita food production and income, many countries may have delayed too long in implementing effective family planning policies. They may now face a choice: adopt a one-child family goal or accept a decline in living standards. It is

Table 10-2. Projected Population Size at Stabilization and Increase Over Current Level, Selected Countries

Country	1988 Population	Projected Population When Stationary State is Reached	Ratio
	(million)	(million)	
Kenya	23	121	5.3
Uganda	16	82	5.1
Tanzania	24	123	5.1
Nigeria	112	529	4.7
Ethiopia	48	205	4.3
Zaire	33	142	4.3
Sudan	24	101	4.2
Ghana	14	58	4.1
Pakistan	107	423	4.0
Syria	11	42	3.8
Algeria	24	81	3.4
Bolivia	7	24	3.4
Iran	52	169	3.2
Bangladesh	109	342	3.1
South Africa	35	90	2.6
Egypt	53	132	2.5
Peru	21	48	2.3
Philippines	63	137	2.2
Mexico	83	187	2.2
India	817	1,698	2.1

SOURCE: World Bank, *World Development Report 1988* (New York: Oxford University Press, 1988).

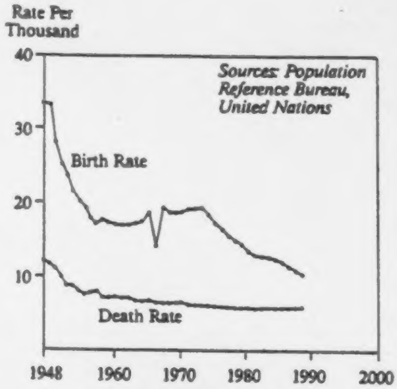


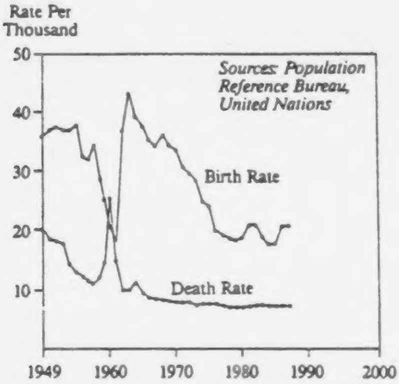
Figure 10-1. Crude Birth and Death Rates in Japan, 1948-88

hard to imagine anything more difficult for a society than striving for acceptance of a one-child family goal except suffering the consequences of failing to do so.

At this point, the only socially responsible step for the United Nations, the World Bank, and the international development community is to call for a sharp reduction in the world growth rate, one patterned after the rapid declines in fertility that occurred in both Japan and China. (See Figures 10–1 and 10–2.) In effect, each of these countries halved its rate of population growth within a matter of years.[56]

Following the loss of its wartime empire, Japan was faced with the reality of living largely on the resources within its own national borders. Living conditions deteriorated, leading many Japanese couples to want smaller families. This in turn prompted public discussion about population control. The Japanese government responded by legalizing abortion in 1948 and creating a national family planning program to provide contraceptive information and counseling. The result was a drop in fertility "unprecedented in the annals of world demography." Between 1949 and 1956, Japan cut its population growth rate from just under 2.2 percent to scarcely 1 percent. Remarkably, Japan made this demographic advance before the advent of modern contraceptives, such as the pill and the intrauterine device.[57]

Two decades later, the Chinese government also concluded that its fast-falling population/land ratio was threatening its future economic progress. This led to a decision to lower its birth rate. Between 1970 and 1976, China's popu-



Sources: Population Reference Bureau, United Nations

Figure 10-2. Crude Birth and Death Rates in China, 1949-87

lation growth rate dropped from 2.6 percent per year to 1.3 percent. Although starting from a slightly higher point than Japan, it nonetheless cut its growth rate in half.[58]

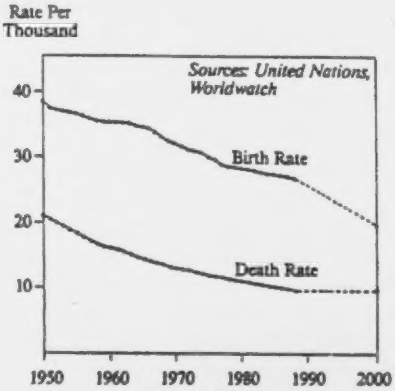
These family planning breakthroughs in Japan and China are indicative of what nations can do if they are serious about slowing population growth. Countries that now want to reduce their birth rate can draw upon the experience of these two pioneers. And they have the advantage of a wider range of modern contraceptive technologies.

Given the experience of Japan and China, a global effort to cut world population growth in half by the year 2000 does not seem out of the question. The birth rate for the world of 28 per thousand population in 1988 is lower than the 33 per thousand that prevailed in Japan and China when they launched their fertility reduction campaigns. The 1988 world death rate is 10, midway between the 12 in Japan and the 8 in China when their efforts began. If national governments become serious, it is possible to lower the global birth rate of 28 to 19 by the end of the century, a decline of one third. Assuming that the death rate for the world remains at roughly 10 per thousand, this would cut the rate of world population growth in half, dropping it below 1 percent per year. (See Figure 10-3.)[59]

Much of this decline would have to occur, of course, where population growth is most rapid—Africa, Latin America, and the Indian subcontinent. Industrial countries, such as the United States, the Soviet Union, and Japan, where population growth is now well below 1 percent per year, can easily follow the industrial societies of Western Europe to zero population growth.[60]

Countries that have made the shift to small families typically have four things in common: an active national population education program, widely available family planning services, incentives for small families (and in some cases, disincentives for large ones), and widespread improvements in economic and social conditions.[61]

The starting point for an effective national population education program is a careful look into the future, a set of alternative projections that relate population growth to environmental support systems and economic trends. The model for this continues to be the projections undertaken in China in the mid-seven-



Sources: United Nations, Worldwatch

Figure 10-3. World Birth and Death Rates, 1950-88, With Projected Goal for 2000

ties as part of the post-Mao reassessment. One of the questions asked was, What will the future be like if each couple has two children? Under this assumption, the country would have added some 700 million people, roughly another India, to its population. When related to the future availability of soil, water, forest, energy resources, and jobs, it became clear that a two-child family would lead to a decline in living standards. China's leaders realized that only a one-child family was compatible with the goals and aspirations of the Chinese people.[62]

This information was then used in public discussions and debates, all the way down to the village level. People were involved in considering whether to accept two or more children per family and a decline in living conditions or to move quickly to a one-child family program and a more promising future. However difficult the choice, China opted for the latter, enabling it to achieve levels of infant mortality and life expectancy that approach those of affluent industrial societies.[63]

Undertaking these studies is an area in which international development agencies can be of major assistance. The key to meaningful projections is the integration of national demographic, economic, and ecological trends. Only when the three are combined can a useful view of the future be achieved. Only then do the choices become clear.

Another step with a potentially high payoff is the provision of family planning services to those not yet reached by existing service networks. Recent surveys in developing countries indicate that many women who wish to limit family size do not have access to family planning services. Few efforts to improve the human condition will pay a higher return on investment than filling this family planning gap.[64]

Societies that have quickly reduced family size have often relied heavily on a combination of incentives for small families or disincentives for large ones. Countries such as China, Singapore, and South Korea have typically offered free health care and in some cases free education through secondary school if couples agree to have only the one child or two children that circumstances call for. This approach is appealing because the free health care helps assure children's survival and the free education helps enhance their earning power, thus increasing the long-term financial security of parents in societies where people depend on their children in old age.[65]

In developing countries, many women who wish to limit family size do not have access to family planning services.

Any meaningful effort to slow population growth quickly will thus depend on heavy additional investments in the provision of family planning services, improvements in education and health, and financial incentives that encourage couples to have smaller families. Although such a broad-based effort could easily involve additional expenditures of $30 billion per year, it can be viewed by industrial societies, who would help provide financing, as a down payment on a sustainable future, an effort to protect the habitability of the planet.[66]

The formulation of population policies and the design of family planning programs are both handicapped by a lack of information. Although changes in birth rates may have a far greater effect on future economic and social trends in developing countries than any other economic trends will, few such countries regularly collect and publish these data. The U.N. *Monthly Bulletin of Statistics* normally includes data on birth and death rates for only 34 countries, nearly all industrial ones.

If the United Nations could launch a monthly report on population and population-related issues and indicators, it would help fill an information gap that handicaps many family planners. Such a report could include information on national goals to reduce family size and progress in extending family planning services. A monthly population report could also provide national analyses of the characteristics of successful family planning efforts, material on the kinds of contraceptives that work best under various conditions, and country-by-country progress in restoring a balance between births and deaths.

At the national level, it now seems reasonable to expect governments to set family planning goals that will lead to improved living conditions. Some countries may find it necessary to press for one child per couple until the momentum of their population growth is checked. But for the world as a whole, two children may now be a more realistic goal. Accumulating evidence suggests that this is the only population policy that is consistent with restoring a worldwide improvement in living conditions. It is time for international leaders, such as the Secretary General of the United Nations and the President of the World Bank, to urge adoption of such a goal by all governments.

Mr. **Scheuer**. I am going to take the liberty of asking you a question. It is on the tip of my tongue, because you referred to one side of the problem, that is the food riots that come when governments start inching prices up. The other side of that coin is, is it not, that when food prices are pegged so low to accommodate the political problems of the urban peoples who are the ones who revolt and the ones that engage in revolution, and so forth, that frequently provides little or no incentive for farmers to raise food for sale to the people in that country, and they simply engage in subsistence agriculture. And that policy in the Third World of pegging food prices so low as to discourage local food production, along with our P.L. 480 program of distributing food, have been cited by some as part of the—of course, it is not so simplistic as to be the cause, but contributing causes that militate against the ability of the Third World to become food self-sufficient. The Nobel Prize economist by the name of Borlaug, who I am sure you are familiar with, says that P.L. 480 is the major cause of inadequate food production in the developing world.

How do we solve that conundrum?

Mr. **Brown**. There is no question but that food aid improperly introduced into a society can depress prices and discourage agricultural development. That has happened. It has happened in a lot of countries. It is possible to introduce food aid, if used to feed marginal populations, to work on public works projects, for example, building irrigation ditches or roads or what have you, it can be done in a way that does not depress prices. Unfortunately, it is not always managed properly.

The broader issue that you touch on, the issue of price, I mean, we are concerned with price on the demand side, because if it is too high, hungry people can't get enough food to keep body and soul together. On the other hand, if it is too low, we don't have the stimulus to get the additional production that is needed. A lot of governments have been guilty, particularly in Africa, of having urban- oriented food policies rather than producer-oriented ones, and as a result, have become food deficit. Those policies are beginning to change now, but over the longer term, the real issue that the world faces is that as the pressures on resources become greater—soil and water and so forth—and as the response to the increased use of fertilizer, at least in some parts of the world, falls off rather rapidly, that the additional price rise needed to get another increment in production becomes very substantial and rises above the level that many of the world's poorer people can pay.

So if you want an economic model that captures the human dilemma in the late 20th and early 21st century, that food price model may well do it, in my opinion.

Mr. **Scheuer**. I consider myself a pretty good horseback economist, I was an honor student at Swarthmore College in economics, but agriculture economics absolutely baffles me. So I am not going to comment, but that certainly is one of the great problems that we really need to think through and come up with some answers, and I appreciate your answer.

Okay. Dr. Hopkins, Chairman of the Political Science Department at my old alma mater, Swarthmore College. Please take your five or six minutes and just chat with us informally.

For the whole panel, your prepared statements will be introduced in full in the record.

STATEMENT OF DR. RAYMOND F. HOPKINS, CHAIRMAN, DEPARTMENT OF POLITICAL SCIENCE, SWARTHMORE COLLEGE

Dr. HOPKINS. Congressman Scheuer, thank you very much for the opportunity to testify before you on this important issue of food, population and the environmental impacts. I think that earlier testimony makes clear that in the 1990s, it is going to be crucial with respect to addressing these kinds of issues. As you point out, as a political scientist, and indeed, someone who teaches food policy among other things at Swarthmore College, my contribution, it seems to me is to focus on the implications of the political and economic measures of the growing scientific understanding that had been represented in some of the earlier papers and which Lester Brown and my other colleagues on this panel have been able to assemble or themselves have uncovered through their research.

Let me suggest that my observation is that there is a growing consensus among scientists that food security is both a cause and an effect of serious threats to our global environment. A dangerously high population growth, expansion of agriculture onto marginal lands, lands quickly depleted, of course, of their resources, deforestation, excessive urbanization and deteriorating standards of living for the poor, both result from and, in turn, cause problems for food security. So I see it very much as a central element in, for example, exacerbating population growth and at the same time exacerbating degradation of the environment, and those two, in turn, increasing food insecurity.

Now this consensual knowledge, if you like—a piece of jargon from my discipline now—provides the basis for changing national and international policy. For the United States, the goal should be to act as a model for other countries in our own national policy on the environment and on food production.

Secondly, however, with respect to the prepared statement that I addressed most of my attention to, I think we have a responsibility to regain leadership among industrialized countries in providing foreign assistance and food aid to address these very pressing concerns. Food aid, in particular, which has just been mentioned, can play a very constructive role, if it is used appropriately, to overcome a number of the problems that have been pointed to.

Last October, the National Academy of Sciences held a conference projecting food aid needs for the 1990s. Compared to the 10 to 12 million in total food aid provided by donor countries today, their estimation was somewhere between, let's say, 20 and 54 million tons of food aid would be needed by the end of this century. The average estimate, something on the order of 37 million tons. In other words, something three to four times current levels, and this is simply to maintain domestic stability of food prices and food availabilities in developing countries, where there is enormous growth expected in food imports.

Well, in light of that analysis, it would seem appropriate for the United States to resume the kind of leadership that it once exhibited in food aid when it established the food aid regime in the 1950s and helped establish the rules and principles for transactions of this kind that are supplemental to the larger trading system in the world by which people can adjust their food deficits and use the trade that takes place as a way to resolve food insecurity.

Now how could this be done? It seems to me most simply we have to set an example that will allow, among other things, policy coordination and increased food provision by other industrialized countries who, unlike the United States, are not food or agricultural exporters. To achieve this goal, five steps would be appropriately taken by appropriate committees of Congress in modifying existing legislation, most profitably in consultation and in possible concert with the administration.

These are establishing food needs as a principal allocation priority for food aid. Let me just point out that currently if one looks at the allocation priorities, and there are some tables and charts in my testimony, it is quite clear that the need of a country does not play a primary role in the allocation of food aid. I think some of the earlier testimony spoke to this also.

Second, establishing modalities whereby needed tonnages of food aid particularly for the most stressed populations and locales, currently heavily in Africa, as Mr. Brown just pointed out, would be protected from price fluctuations.

Third, streamlining food aid to make it a fully grant program and one related to prospects for debt forgiveness. I think this is particularly important in countries where such assistance is appropriate in support of economic policies to stimulate development, such as the kinds of changes you mentioned were taking place in Africa but not necessarily in Kenya, as earlier testimony pointed out, and to cushion economic sacrifices—the problem of declining services and so on that you yourself alluded to, Congressman, which are required to enhance domestic investment and frugality by the population as a whole.

Fourth, policy coordination and cofinancing should be enhanced among all donors.

Finally, projects that attack fundamental problems leading to food insecurity, including high population growth, rapid urbanization, deteriorating soil and forested land and the waste of harvested grain. All these should be given high priority for the use of food aid resource.

Precisely as Lester Brown just said, unless we target our food aid for an end use of these sources, attack these very central problems, not just in the economies of these overseas countries which have global implications because of the external effects that they will have in the global economy, I think that the food aid will simply not be used well, and that is one of my major concerns.

In conclusion, I suggest these prescriptions may more precisely be put forward as reforms to the existing PL 480 legislation and implementation. And of course, the reforms I would talk about refer to some steps in the foreign assistance legislation this year and to the farm bill coming up for consideration next year. The aim is to establish changes in what I call the international regime for food aid with new guidelines and rules for the use of this food aid.

Thank you.

[The prepared statement of Dr. Hopkins follows.]

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Statement for the Subcommittee on
Natural Resources, Agricultural Research and Environment
Committee on Science, Space and Technology
U.S. House of Representatives

THE IMPLICATIONS OF U.S. FOOD AID FOR GLOBAL ENVIRONMENTAL AND POPULATION PROBLEMS

Raymond F. Hopkins
Swarthmore College

February 28, 1989

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Deforestation, soil degradation and deteriorating living conditions have been associated with growing world population and the need to provide food for these rising populations, especially in developing countries. The threat these pose is well documented by agronomists, demographers and other scientists. The proper role of advanced industrialized states in addressing this threat is two-fold: first, to set an example in their own behavior regarding the preservation of the environment and the pursuit of responsible population policies; and second, to provide most severely affected states with economic assistance to counter these pressures and to alter resistant political forces. In many states political leaders appear indifferent to high population growth and environmental threats both of which harm global and hence American interests.

In this second role, providing assistance, the U.S. is a major player. Addressing global threats associated with inefficient food production and the environmental deterioration caused by population growth is a central task of our foreign assistance (Woods, 1989). Until 1989 the U.S. was the world's largest contributor of development assistance; we now stand second to the Japanese and, in fact, well behind Europe taken as a whole. The decline in the role played by the U.S. as an aid provider is greater than our relative decline economically among Western states. Shrinking aid seriously limits our capacity to address longer-term global problems such as the negative effects of population growth.

One possible exception to this U.S. decline is food aid where the U.S. continues to be the leading donor, providing 55-65 percent of the total world tonnage and 40-45 percent of the costs. In FY 1988 food aid

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was 25 percent of the U.S.'s bilateral economic assistance provided through AID. The U.S. use of food aid, however, has not been directed toward long term problems of environment or high population growth. Nearly one-half of U.S. food aid, over $500 million of FY 1988's $1.1 budget for food (excluding delivery and maritime subsidy costs), went to countries with little or no food insecurity. "Food insecurity" can be defined as the condition in which states that have high national caloric deficiencies and infant mortality rates — indicative of chronic hunger — and have high dependence on food imports with little foreign exchange. For economically capable states, such as Japan, Korea, Egypt and Brazil, commercial imports can and do provide food security. In the twentieth century, efficiencies in food trade have greatly expanded world interdependence and the ability of states to use trade as a coping mechanism to achieve food security (Hopkins, 1987).

Commercial trade cannot handle this problem for other states, however. Thus national food insecurity, with its association with urban unrest, land pressures and soil deterioration, exists at chronic levels in countries such as Bangladesh, Ethiopia, Haiti, Mozambique, Somalia, and Zaire. In recent years these states have received far less U.S. aid compared to their "needs" than have other more secure countries such as Egypt, Jamaica, and Pakistan. India belongs in this category also; it has substantial arable land, it imports less than one percent of its cereal needs and it has recently been a food aid donor. Yet India is the third largest U.S. food recipient in value terms. Cash sent for nutrition programs would have substituted more efficiently for much of the food aid (see Tables 1, 2, and

Table 1

Low-Income Food Deficit Countries-Top 20 by Food Aid Imports[1]

Rank and Name	Pop.[2]	Pop.[3] Growth Rate	'000 Tons '87/'88[4]		Percentage Imports From Aid	US Food Aid		Percentage Food Aid From Us
			Food Imports	Total Food Aid		$mil.[5] FY 87	'000 Tons[6] 86-87	
1. Bangladesh	103.2	2.6%	2911	1778	61	95	723	41
2. Egypt	49.7	2.7%	8628	1621	19	197	1496	92
3. Ethiopia	43.5	2.4%	1353	1212	90	5	221	18
4. Sudan	22.6	2.8%	667	638	96	60	609	95
5. Mozambique	14.2	2.7%	503	503	100	0	90	18
6. Philippines	57.3	2.5%	1271	346	27	45	320	92
7. Sri Lanka	16.1	1.5%	859	304	35	29	244	80
8. El Salvador	4.9	1.2%	276	276	100	44	208	75
9. Somalia	5.5	2.9%	301	247	82	11	29	12
10.India	781.4	2.2%	724	245	34	84	208	85
11.Bolivia	6.6	2.7%	310	240	77	30	175	73
12.Indonesia	166.4	2.2%	1915	216	11	41	36	17
13.Haiti	6.1	1.8%	217	212	98	19	75	35
14.Morocco	22.5	2.5%	2132	911	9	59	604	66
15.China	1054.0	1.2%	15551	190	1	0	0	0
16.Nicaragua	3.4	3.4%	228	180	79	0	0	0
17.Honduras	4.5	3.6%	172	168	98	13	129	77
18.Dominican Republic	6.6	2.4%	520	166	32	29	117	70
19.Zaire	31.7	3.1%	340	147	43	22	48	33
20.Kenya	21.2	4.1%	195	139	71	9	86	62

1. Rankings according to food aid in cereals. (See Note 4.)
2. In millions, as of mid-1986. Source: World Development Report 1988.
3. Percentage based on 1980-1986. Source: World Development Report 1988.
4. Thousands of tons of cereals allocated, committed, or shipped (estimated figures). Source: Foodcrops and Shortages - FAO Special Report, No. 11, Nov. 1988.
5. Source: AID, Table 7 figures.
6. In total cereals. Source: Food Aid in Figures 1988, #6.

Table 2

Land and Production Changes in the "Top 20" Countries

	Name	Percent[1] Arable Land	Percentage Change in[2] CerealProduction Per Acre 1974-84	Average Annual[3] Deforestation Rate 1979-1983	Average Annual[4] Change in Arable Land Area, 1974-1984
1.	Bangladesh	68	+16	-0.6%	-0.0%
2.	Egypt	3	+10	0.0%	+2.5%
3.	Ethiopia	11	+ 8	-0.5%	+0.2%
4.	Sudan	5	-38	-0.6%	+0.1%
5.	Mozambique	4	-10	-0.8%	0.0%
6.	Philippines	38	+33	-1.2%	+1.3%
7.	Sri Lanka	33	+59	0.0%	+0.5%
8.	El Salvador	35	+23	-4.1%	0.0%
9.	Somalia	2	- 7	-0.6%	0.0%
10.	India	51	+31	-0.0%	-0.0%
11.	Bolivia	3	+14	-0.1%	+0.1%
12.	Indonesia	11	+45	0.0%	+1.2%
13.	Haiti	32	-12	-1.0%	+0.4%
14.	Morocco	19	-21	0.0%	+2.1%
15.	China	11	+57	-2.5%	+0.1%
16.	Nicaragua	10	+79	-2.4%	+0.5%
17.	Honduras	16	+23	-1.9%	+0.2%
18.	Dominican Republic	30	- 6	-0.3%	+1.3%
19.	Zaire	3	+ 9	-0.2%	+0.8%
20.	Kenya	4	-27	-1.2%	+0.4%

1. 1983 figures, rounded. Based on arable and permanent crops land divided by total land area, except for the Djibouti figure, which is permanent pasture divided by total land area. Source: 1984 FAO Production Yearbook.
2. Percent change over time span. Based on ('84 figures minus '74-'76 figures) divided by '74-'76 figures. Positive figures indicate that the production in kilograms per acre is increasing; negative figures indicate that the production is decreasing. Source: 1984 FAO Production Yearbook.
3. Based on ('83 figures minus '79 figures) divided by '79 figures and divided by 4, to produce the average rate of change per year. The negative figures indicate that there are less forest and woodland areas now than there were before. Source: 1984 FAO Production Yearbook.
4. Figures calculated as in note #2. Positive figures indicate an increase in arable and permanent crops land; negative figures indicate a decrease. Source: 1984 FAO Production Yearbook.

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7). Further, much U.S. aid to the most desperate food insecure states has not been targeted for use in projects such as deforestation or land restoration; rather it has been in the form of emergency give-aways required by the legal mandates under which AID operates, even in cases where administration officials find such uses less desirable. As a result, food aid has not been a significant contributor to attacking environmental problems. Indeed, it may have contributed to their acceleration through easing the burden on developing countries, especially in Africa, to address issues of policy reform and to give high priority to reforestation and more ecologically sound agricultural practices (Hopkins, 1988).

The potential for U.S. assistance, particularly food aid, to redress the problems created by high population growth rates and deteriorating agricultural land is seriously limited by the constraints and priorities placed on the Agency for International Development. Indeed, Alan Woods, the Agency's Administrator, reported similar criticism just last week in a report made public and in testimony to Congress.

The conclusion I reach from the above situation is that it is appropriate for serious redirection and legislative redrafting of the authorization for our foreign assistance program, including particularly our Food for Peace (PL480) Program. Frankly, our practices and rules for use of this declining resource have become increasingly out of step with more global needs and the priorities of other donors. A large gap has grown over the last two decades between the understanding about linkages among growing populations, pressure on agricultural land, environmental degradation, and global threats our physical and economic environment. At the same time, the rules and practices by which AID is administered and the legislative and budgetary constraints under which it must operate have failed to keep pace with this growing understanding. The time is right, therefore, for substantial overhaul of the Food for Peace Program (PL480).

I. SCIENTIFIC CONSENSUS ON PROBLEMS

Over the last twenty years there has been a growing consensus among scientific experts in demography, environment and agriculture regarding the linkages among population, food needs and pressures on the environment. These linkages are appropriately the subject of careful investigation. While each national context presents a particular pattern of relationships and varying degrees of concern for negative external consequences, the global importance of these linkages is increasingly understood and accepted in the scientific community. As a political scientist, my understanding of the scientific evidence argues that a serious global threat, one of growing proportion, is arising from the rapid growth of population in developing countries and the stagnant and even declining standards of living faced by that population. One consequence of this population growth is increased demand for food and growing pressure on arable land, increasingly land of marginal value for production, to secure additional food. Agronomic practices which in earlier periods were ecologically stable have been altered as agriculture has intensified the use of land and moved into these marginal lands. Consequently, the rate of deforestation in countries ranging from Brazil and the Ivory Coast to Ethiopia and Nepal are large and rising. Efforts at reforestation and the protection of the environment, begun principally in the last decade, fall short of offsetting these insults to the environment. Negative externalities arise in the form of population flows into urban areas and exit from the country itself to more economically attractive locations in the northern hemisphere as well as ecological damage that further threatens to destabilize climatic patterns and expand desert conditions. Clear-cutting of trees and overcropping of land, for example, has consistently led to this (Brown, 1988). Just as "consensual knowledge" has grown rapidly in the last decade on threats from the ozone layer depletion and the "greenhouse effect," so also our understanding of linkages between proper and improper agronomic practices in the use of land and the ability to protect ecologically important forests has improved dramatically. Knowledge about how to increase yields per acre on extant arable land has likewise increased. Experiences of the impact of the green revolution in Asia, as well as assessments of the prospects for Africa, highlighted for example by recent studies of the International Food Policy Research Institute, give evidence that we know a considerable amount about what should be done (Mellor, 1987).

Prescriptions, however, often focus on the need for developing countries to change their policies or to adopt technologies that are out of their reach thanks to high debt and a limited pool of well trained people. Thus recommendations for improving agricultural production and marketing or for protecting the environment are frequently accepted in less developed countries without substantial or effective action to implement them. This, in turn, creates turbulence within these countries and a degree of discontent between donor countries and LDCs where these problems are

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increasingly acute.

A common interest to political economists is the relationship between developing countries' reliance on export-led growth, which in turn increases the burden on the government to extract financing from the agricultural sector, and low rates of return on private sector investments outside of agriculture. Turbulence exists between the developing and developed world over this issue. Compounding the situation is the very basic problem of debt repayment. To address some of the problems of concern to this Committee, as well as other issues of international cooperation in the economic sphere. Opportunities for mutual long-term gain, often difficult to achieve, must be pursued and the exacerbation of hostilities through competing interpretations as to who is to blame for developing countries' problems of environment and improved agriculture must be avoided.

II. U.S. NATIONAL INTEREST

National interest is the basic rationale for the donation of U.S. resources and advice to alleviate environmental, population and food need of developing countries. National interest, however, is defined competitively by different groups in our society for these issues. One result, consequently, is a stagnation of policy. Food aid provides an excellent example. The PL480 legislation enacted in July, 1954, stipulated a set of multiple purposes for which food aid was to be used: promotion of agricultural exports, the nurturance of friendly diplomatic ties, the promotion of economic development, and the humanitarian relief of people

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unable to feed themselves (Caldi, 1987). During the 1950s and 1960s, when the United States was virtually the sole provider of food aid and when competition for international markets was less severe, food aid played an important supplementary role in the world trading system. It simultaneously helped countries such as Korea, Taiwan, India and Pakistan to improve their economic position and, in the case of India, to survive a disastrous agricultural period in 1965-66. In the last two decades, however, the role of U.S. food aid has often been subordinated to diplomatic/military interests, for example in providing food during the Vietnam War to our "allies," in promoting a Middle East alliance with Egypt, and in sustaining military bases such as those in the Philippines.

At the same time, particularly in the 1980s, the European Community became less a food importer and more a competitor in world markets. In response the U.S. has used its food aid as one more weapon in an effort to improve its competitive position in the world. Resources available to meet emergency needs of food aid were serendipitously available in 1984-85, a period of drought and famine in Africa, thanks to a large surplus of grain available in the U.S. The $500-600 million that emergency food targeted to Africa cost, was small in comparison to the outlay of up to $25 billion annually during the height of the U.S. grain abundance era in the 1980s.

These examples indicate that the multiple purposes built into the legislation create an increasing tension between a growing need and restrained capacity to attack food insecurity and the attendant consequences it engenders in higher population growth, weakened human capital and land degradation. This view rests on a scientific consensus.

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The continuing pressures from commercial and diplomatic interests to target assistance, in this case food aid, as such, for purposes which have little direct positive impact on these problems and which in certain instances are discernably counterproductive is not in the U.S. interest.

Clearly this statement is argumentative. How does one seriously weigh competing claims to serving the national interest? The answer lies simply in the cost effectiveness of the benefits one derives from alternative uses, appropriately discounted for time. In case after case evidence mounts from studies by scientists examining the impact of food aid that, where it has been given for diplomatic and commercial reasons or for quick, in and out, and often late responding emergency efforts, its impacts have not served basic food needs or offset global problems that spread beyond the borders of the individual country (Clay and Shaw, 1987).

As a result there is substantial literature debating the appropriate priorities for food aid. Many economists, nutritionists and development experts have lamented the squandering of this resource based on their perception of American interests. On the other hand, commodity interests such as those representing dairy, wheat and rice producers, have frequently complained that some food aid allocations have subverted the purposes of the original legislation which explicitly indicates theirs is one of the legitimate interests to be served. Furthermore, State Department leaders have regularly asserted the importance of looking at a total dollar volume provided to friendly countries as a key ingredient in successful foreign policy. Such officials have increased rather than decreased their interest over the last two decades in using food aid as an integrated dollar contribution. It is seen as one part of the overall support our country can provide other governments in an effort to cement ties of friendship and cooperation. While these latter two interests are both legitimate and undeniably components of the total national interest, there is virtually no instance in which the supply of food aid to a country, when based principally to serve commercial or diplomatic priorities, would not have been as well or more efficiently displaced by direct dollar assistance. The Department of Agriculture, for example, when it sought to expand its support for the export of American agricultural products in the mid-1980s, turned only modestly to its influential role over food aid allocations. Instead it developed more single purpose and targetable instruments for export promotion, such as the Export Enhancement Program for which hundreds of millions of dollars of additional funding was appropriated by the Congress. Subsidizing loans to pay for other states to import food, the forgiveness of debt or the use of direct economic assistance, such as the ESF funds, provide tools for the use of the State Department and the Department of Defense in their relations with other countries. A tied commodity instrument such as food aid is clearly a second best resource for these policy makers. Similarly the Department of Agriculture would clearly prefer expanding food exports through tailored loans made possible by Export Enhancement programs. Even under food aid surplus disposal mechanisms, developed with Title 416, the additional use of food within PL480 channels was separated from the longer-term trade promotion and friendship goals precisely because it was an unreliable surplus disposal mechanism.

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An additional consideration with respect to U.S. national interest is the problem of "declining hegemony." This phrase refers to the historic role played by the United States in the construction of the international rules and codes of conduct for trade, environmental protection, agricultural technology, and a wide variety of other activities involving transactions among states and the diffusion of technology and culture (Keohane, 1984). The U.S. hegemonic condition at the end of World War II allowed it to exercise leadership and provide collective benefits to many states through establishing international regimes that promoted cooperation and development. In addition, as mentioned at the outset, another obligation of leadership is, for states, within their own boundaries, to pursue policies that serve as a model for others. Thus, United States' population policy, environmental policy, and regulation of agriculture all bear upon the model we establish for other states. Equally important is the burden borne by the United States, especially heavy in the post war years, in establishing the international financial institutions, international agricultural research institutions, and the norms for economic policy that expanded employment and directly attacked threats to human dignity from poverty and hunger.

The food aid regime which the United States fostered in the 1950s has undergone significant evolution over the last 35 years (Hopkins, 1987). Currently the United States is the only food aid provider to give a substantial portion of its aid in the form of loans rather than grants. Furthermore, it is the only provider in which trade promotion interests, represented through the Department of Agriculture, play a strong role in determining priorities and approving specific actions. While all countries attend to domestic interests in pursuing their economic foreign policy, the United States' role, particularly in the area of food aid, is quite anamalous with its position as the largest and most visible donor. In recent years the United States has slipped from being a leader in the formation and implementation of norms adapted to changing needs and scientific understanding to being a follower. As such, this represents a real cost. At the very time the United States seeks to encourage other countries, for example Japan, to expand their purchases of food from the United States to address international economic problems, it uses its own food aid in ways that it encourages others not to do. Not only do Japanese domestic interests see little benefit in Japan providing food aid, but also the model the U.S. provides for allocating aid, with its strong element of commercial and diplomatic interests, give little credence to the proposals to Japan for co-financing and policy coordination. Thus long-term U.S. interest in establishing greater burden-sharing for international responsibilities in foreign assistance are undercut by the perceived hypocrisy of U.S. action.

The net benefits of food aid have shifted, I argue. Those portions of food aid targeted without attention to food insecurity, environmental and population pressures, problems linked in a close nexus to growing inequality and especially to mushrooming urban populations increasingly dependent on food imports, could regularly be replaced with cash support, where diplomacy justifies it or where most effective commercial market expansion can be promoted in conformity with norms of cooperation among

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trading partners. Without such a change, respect for the role of the U.S. as a model donor, notably in providing food aid, will continue to evaporate. As our allies consolidate their position on the use of grant food aid directed toward the alleviation of food, hunger and the associated problem of distorted agricultural production leading to degraded land and deforestation, the U.S. is faced with lagging further behind changing international norms. Indeed, other donors looking at the modest priority accorded the U.S. for using food aid to enhance development and protect the environment, will find little to provide a moral basis for persuading them to move in this direction. Thus the net benefits from targeting food aid to important population and environmental problems has grown over the last two decades, while the net benefits of using food aid for other purposes has been undercut by the damage it does to the reputation of the U.S. and by the cost ineffective impacts within the recipient countries of such aid. In El Salvador, for example, which is among the very top per capita recipients of U.S. aid, the rate of deforestation is four times higher than that of any top recipient (see Tables 3 and 4). Such lost opportunities and the serious threat of environmental stress have been well documented (see Brown, 1988). At the causal center lies the relationship between hunger and poverty (Sen, 1980; Lipton, 1988).

III. NEED-BASED ALLOCATIONS

Let us begin to assess need by focusing on the central causal relationship identified by the population-food-environment equation. Reports frequently discover a linkage between growing population leading to

Table 3

Low-Income Food Deficit Countries-Top 10 by Aid per Capita[1]

Rank and Name	Pop.[2]	Pop.[3] Growth Rate	'000 Tons '87/88[4]		Percentage Imports From Aid	F/A Per[5] Million People	US Food Aid		Percentage Food Aid From US
			Food Imports	Total Food Aid			$mil.[6] FY 87	'000 Tons[7] 86-87	
1. Cape Verde	0.3	2.0%	46	41	89	137	3	15	37
2. Djibouti	0.3	4.2%	33	19	56	62	0	0	0
3. Mauritania	1.8	2.6%	207	107	52	60	5	3	3
4. El Salvador	4.9	1.2%	276	276	100	56	44	208	75
5. Nicaragua	3.4	3.4%	228	180	79	53	0	0	0
6. Swaziland	0.5	3.4%	56	23	41	46	0	1	4
7. Somalia	5.5	2.9%	301	247	82	45	11	29	12
8. Honduras	4.5	3.6%	172	168	98	37	13	75	45
9. Bolivia	6.6	2.7%	310	240	77	36	30	175	73
10. Mozambique	14.2	2.7%	503	503	100	35	0	90	18

1. Based on tonnage of Food Aid allocated, committed, or shipped divided by population.
2. In millions, as of mid-1986. Source: World Development Report 1988, except for population figures for Cape Verde and Djibouti, which are from Webster's Ninth New Collegiate Dictionary.
3. Annual %age based on 1980-1986. Source: World Development Report 1988, except for figures for Cape Verde, Djibouti, and Swaziland, which are from the United Nations Demographic Yearbook 1986.
4. Thousands of tons of cereals allocated, committed, or shipped (estimated figures) for 1987/1988 or 1988. Source: Foodcrops and Shortages - FAO Special Report, No. 11, Nov. 1988.
5. In tons. Based on Food Aid tonnage of cereals divided by population.
6. Source: AID, Table 7 figures.
7. In total cereals. Source: Food Aid in Figures 1988, #6.

Table 4

Land and Production Changes in the "Top 10" Countries

	Name	Percent[1] Arable Land	Percentage Change in[2] Cereal Production Per Acre 1974-84	Average Annual [3] Deforestation Rate 1979-1983	Average Annual [4] Change in Arable Land Area, 1974-1984
1.	Cape Verde	10	+10	0.0%	0.0%
2.	Djibouti	9	[no figures given]	0.0%	0.0%
3.	Mauritania	0.2	-30	0.0%	0.0%
4.	El Salvador	35	+23	-4.1%	0.0%
5.	Nicaragua	10	+79	-2.4%	+0.5%
6.	Swaziland	0.2	+24	-0.5%	-7.1%
7.	Somalia	2	-7	-0.6%	0.0%
8.	Honduras	16	+23	-1.9%	+0.2%
9.	Bolivia	3	+14	-0.1%	+0.1%
10.	Mozambique	4	-10	-0.8%	0.0%

1. 1983 figures, rounded. Based on arable and permanent crops land divided by total land area, except for the Djibouti figure, which is permanent pasture divided by total land area. Source: 1984 FAO Production Yearbook.
2. Percent change over time span. Based on ('84 figures minus '74-'76 figures) divided by '74-'76 figures. Positive figures indicate that the production in kilograms per acre is increasing; negative figures indicate that production is decreasing. Source: 1984 FAO Production Yearbook.
3. Based on ('83 figures minus '79 figures) divided by '79 figures and divided by 4, to produce the average rate of change per year. The negative figures indicate that there are less forest and woodland areas now than there were before. Source: 1984 FAO Production Yearbook.
4. Figures calculated as in note #2. Positive figures indicate an increase in arable and permanent crops land; negative figures indicate a decrease. Source: 1984 FAO Production Yearbook.

pressure on marginal arable land and existing forests with the result that, in spite of intensification of agriculture inputs, there is a decline in productivity and an important loss to the environment. Accompanying this is the decline in rural incomes and migration to the cities. The growth of urban centers in developing countries has ranged between 5 and 10 percent per annum over the last decade. The result of this is that urban centers are doubling every seven to fifteen years. This has already placed enormous strain on major countries in the Third World. The largest cities in Latin America and Asia and a few in Africa are now extraordinarily crowded and place overwhelming demands on urban infrastructures — physical resources, social services, and marketing abilities. Urban populations are more vulnerable to fluctuations in food prices and lack fewer alternatives when they become unemployed or food prices rise. A number of recent studies have documented this phenomenon in all three continents of Asia, Africa and Latin America. The work of the Cornell nutrition surveillance group and recent studies on food subsidies provide selected cases of this problem (Per Pinstrup-Anderson, 1988). The work of the National Center for Atmospheric Research in Colorado has offered further evidence of these linkages (Glantz, 1987).

Since the 1980s the majority of new projects put forward by the World Food Program (WFP) and by many other bilateral donors using food aid has been directed at agricultural production problems and the threats to the environment that this hearing has identified. Major reforestation projects have been undertaken in countries such as Ethiopia and China, while support for agriculture through land reclamation, improved roads and assistance to

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agricultural workers has been the central focus of new projects. These now constitute the largest portion of the WFP's portfolio and have become increasingly a central concern of European countries. Indeed in the early 1980s European countries gave food sector policies and food security a high priority in their food aid resource transfers and in their development programs more generally. The Canadian International Development Agency (CIDA) has adopted a very similar set of priorities and has allocated its aid with increasing attention to food security needs in a select group of countries where Canada is judged most capable of making a difference. The result of this has been a shift in priority towards what the Food and Agriculture Organization (FAO) calls low income food deficit countries. Some of these countries, notably Egypt, do very well in providing a high level of caloric availability to their population. This is accomplished through massive subsidies based heavily on commercial imports. The result of Egypt's ability to purchase food commercially (see Table 1), and the large caloric availability that has resulted since heavy subsidization of food began in the late 1960s, has led Egypt to have very little claim on food aid on the basis of nutritional need (USDA, 1988).

It is possible to provide a rough rank ordering of countries that are faced with serious problems of low nutrition availability and to relate this to the extent these countries depend upon imports to meet domestic consumption and even more importantly the extent to which these countries face serious population pressures and erosion of their agricultural production. Tables 1, 2, and 5 list the top 20 food aid recipients by total volume and offer a quick profile of their ecological and agricultural

Table 5

Crop Production in the "Top 20" Countries

Name	Cereals[1]	Roots and Tubers [2]	Legumes (Pulses)[3]	Cereal Imports As % of Consumption[4]
1. Bangladesh	22764.	1930. *	218. *	11
2. Egypt	8415.	1420. *	355.	51
3. Ethiopia	4770. *	1182. *	791.*	22
4. Sudan	1939.	308. *	89. *	26
5. Mozambique	576. *	3260. *.	55. *	47
6. Philippines	11680.	3244. *	47. *	10
7. Sri Lanka	2317.	870. *	30. *	27
8. El Salvador	711.	30. *	49.	28
9. Somalia	359. *	40.*	20.	46
10.India	169285.	19650.	12620.	0.5
11.Bolivia	825.	895.	21.*	27
12.Indonesia	41505.	16521.	299. *	4
13.Haiti	433. *	789.	91. *	33
14.Morocco	3721.	550. *	228.	36
15.China	364786. *	158508. *	6198. *	4
16.Nicaragua	494.	30 .*	60.	32
17.Honduras	662.	25. *	52.	21
18.Dominican Republic	487.	255.	89.	52
19.Zaire	1000.	15592. *	157. *	25
20.Kenya	1724.	1446.	250. *	10

1. Thousands of Metric Tons of all cereals combined. 1984 figures. Source: 1984 FAO Production Yearbook.
2. Thousands of Metric Tons of combined roots and tubers. 1984 figures. Source: 1984 FAO Production Yearbook.
3. Thousands of Metric Tons of combined legumes. 1984 figures. Source: 1984 FAO Production Yearbook.
4. Based on total cereal imports divided by (cereal imports plus cereal production). Figures are rounded.

*Unofficial figure.

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Table 6

Crop Production in the "Top 10" Countries

	Name	Cereals[1]	Roots and Tubers[2]	Legumes (Pulses)[3]	Cereal Imports As % of Consumption[4]
1.	Cape Verde	3	12	5 *	94
2.	Djibouti	no listing	no listing	no listing	unavailable
3.	Mauritania	33 *	5 *	19 *	86
4.	El Salvador	711	30 *	49	28
5.	Nicaragua	255 *	30 *	60	47
6.	Swaziland	115	11 *	295 *	33
7.	Somalia	359 *	40 *	20	46
8.	Honduras	662	25 *	52	21
9.	Bolivia	825	895	21 *	27
10.	Mozambique	576 *	3260 *	55 *	47

1. Thousands of Metric Tons of all cereals combined. 1984 figures. Source: 1984 FAO Production Yearbook.
2. Thousands of Metric Tons of combined roots and tubers. 1984 figures. Source: 1984 FAO Production Yearbook.
3. Thousands of Metric Tons of combined legumes. 1984 figures. Source: 1984 FAO Production Yearbook.
4. Based on total cereal imports divided by (cereal imports plus cereal production). Figures are rounded.

*Unofficial figure.

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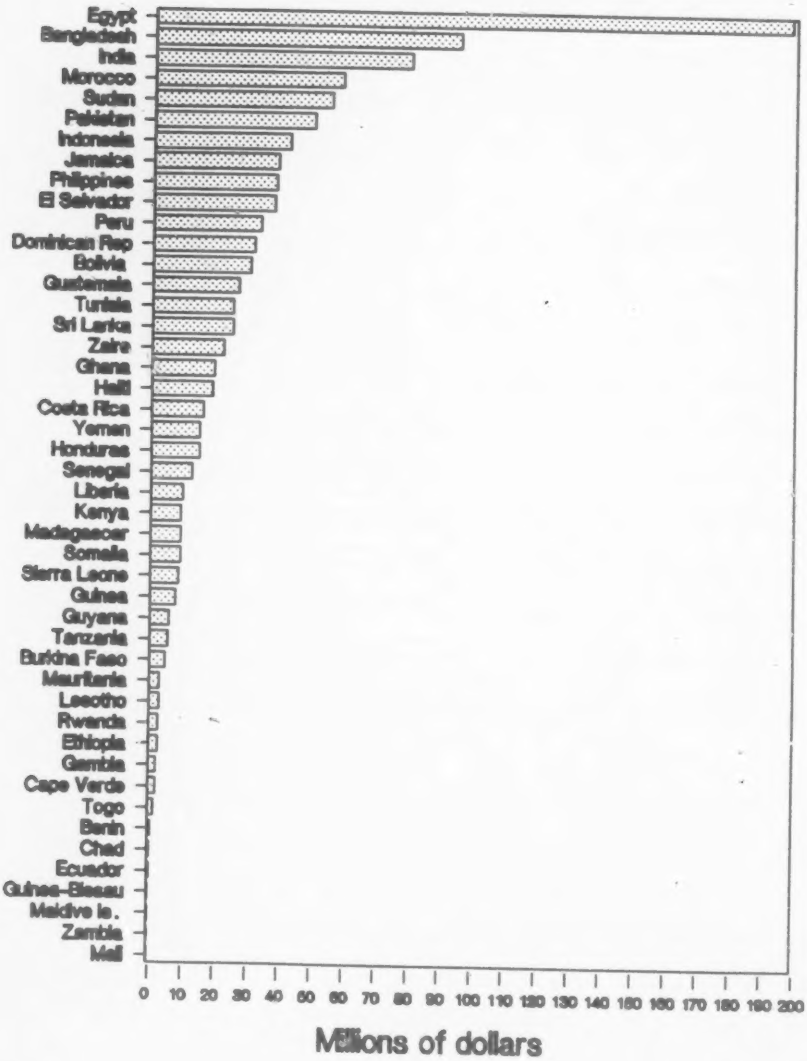
situation. The top recipient, Bangladesh, receives only 40 percent of its food aid from the United States. Imports constitute 11 percent of its cerreal consumption, a substantial but not critical amount, but its rate of population growth has exceeded its capacity to produce domestically. Its vast available arable land is fully utilized and it faces modest to no prospects for expansion, especially in the light of the continuing threat of flooding exacerbated by the heavily deforested watersheds in Nepal (see Table 2). An even more pressing case can be made for countries such as Ethiopia, Somalia, Zaire and Kenya where, in spite of substantial food aid, the application of aid to reforestation and improved agriculture techniques has been modest. Yield increases have been modest or declining in the last decade (Table 2). Indeed, some productivity changes, as Table 2 indicates, have been highly negative. The basic numbers in these tables make clear that U.S. priorities for allocation of food aid bear at best modest resemblence to needs as indicated by problems of population growth, deforestation, and decline of productivity in land. As Table 7 illustrates, U.S. aid goes heavily to such more food secure countries as Egypt, India, Pakistan, the Philippines, El Salvador, Peru, Bolivia, Jamaica and the Dominican Republic. While these countries have substantial population growth, with the exception of Sri Lanka and El Salvador, only a few are constrained by lack of arable land. The FAO reports that Egypt, Mozambique, Somalia, Nicaragua, Zaire and Kenya all have less than 10 percent of their land suitable for agriculture. Countries which are both nutritionally deprived and unable reliably to produce their domestic food needs include Bangladesh, Ethiopia, Niger, Sudan, Rwanda, Somalia, Mali,

Table 7

Ranking of U.S. food aid recipient countries by amount allocated, FY 1987



Mozambique, and for the foreseeable future Afghanistan. Alternatively, thanks to import capability and existing superior levels of per capita nutrition availability, countries such as Jordan, Jamaica, Tunisia, Egypt, Philippines, and Morocco, based on World Bank statistics (1988) and UNICEF (1987), have adequate export earnings to command their needs in the world market. For example, the Philippines and Egypt have infant mortality rates of 78 and 136 per thousand for the 1980s compared to 250 to 300 per thousand for Ethiopia and Mali. In countries with population growth above 3 percent, e.g. Nicaragua, Honduras, Zaire and Kenya, as shown in Table 1, food imports have played a growing role in the proportion of cereal consumed, although in relation to total staple crops including roots and tubers and pulses (Tables 5 and 6), the food dependency of these countries is much less than would appear from focusing solely on cereals.

As indicated in the opening paragraphs, an analysis of countries based on their economic ability to grow or import food and the relative nutritional satisfaction of the existing population allows us to highlight a group of highly insecure food countries. Recall that these countries have few or no options to adjust to declining production or sudden shortfalls (Hopkins, 1986). The United States does provide food aid to these states, but it does so in relatively smaller proportions than it does to countries which are more food self reliant and enjoy a much higher nutrition status such as Egypt and Jamaica. In addition, the highly food insecure states more often suffer from declining agricultural productivity, increasing deforestation and high population growth rates. Further, in a country like El Salvador, which has rapid deforestation, U.S. programs have

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largely ignored that problem. Thus, an overwhelming case can be made for targeting food to food insecure states and tying it to appropriate food production and environmental goals. As the data suggest, food aid provided to these most needy countries comes in a higher percent from countries other than the United States. This simply underscores the earlier observation that the U.S. has fallen behind in taking leadership to address global environmental and agricultural production needs. Potentially explosive situations are developing in the highly concentrated urban populations emerging in the Third World. Cognizance of this danger is required. Otherwise urban based political pressure will accelerate the mining of the earth's soils in the next decade in these poor states.

A point of departure for estimating the role food aid might constructively play, targeting it to countries of need rather than to countries with commercial and diplomatic priority, was a workshop on food aid needs held by the National Academy of Sciences in October, 1988. It indicated that needs are likely to grow, even as world production advances. Drawing upon projections for the decade of the 1990s for world trade in grains, the workshop panel was able to derive rough estimates of food aid needs relying upon the expected portion of food trade needed to stabilize world and domestic markets, looking to cases where grant supported transfers would be needed. Some panelists proposed rather high future estimates based on the meeting of nutritional needs. Others constrained estimates by feasibility judgments. Workshop estimates for the period 1995-2000 ranged, for mid-level or average amounts, between 29 million tons and 54 million tons of cereal equivalent food aid. The average or base estimate was 37 million tons for this 1995-2000 year period. These levels contrast to the 10-12 million ton level for all donors reached in the last four years. Optimistic estimates of expanded economic development in the world's economies coupled with a deepening division of labor in food production led to estimates of (1) increased production world-wide, (2) falling prices, and (3) expanded trade, with particularly large increases in imports by less developed countries.

As a region Africa was singled out as a potential source of difficulty. Simple extrapolations from the 1970-80 period would suggest a dramatic increase in food aid needs in Africa. On the other hand current policy adjustments that seek improved agricultural techniques, more effective use of inputs and available land, and enhanced environmental efforts to prevent soil degradation were all mentioned as factors that might dramatically reduce the dismal prospects forecast for Africa. A changed policy environment, more reliable rainfall, and adoption of the increasingly targeted efforts of agricultural researchers to develop appropriate seeds and techniques for the Africa setting were all mentioned as possible ameliorative events that could offset large food aid needs extrapolated from the recent rapid growth in food import needs in Africa. The disincentives of agricultural policy in Africa were particularly noted as a deterrent to improved agricultural techniques, higher yields and reduced pressures on low yielding land. In addition, the growth of African cities, for which food aid on occasion has been the major resource for providing food security and preventing urban disorder was also touched upon as an important concern. This highlights the claim made earlier that food

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aid, when given as an emergency vehicle may be suboptimal. Without efforts to target aid on asset creation and changed environment, such as in the food-for-work projects leading to reforestation, pressure on African states to reform policies and give greater attention to the fundamental population and food production problems may grow. Certainly the failure of Ethiopia to reform its rather reasonably unsuccessful agricultural policies adopted of the late 1970s and 1980s, at the same time that there has been a growing malnourished population from rebelling areas along with needy refugees from Somalia and Sudan, underscores the way in which food aid, while targeted only for humanitarian relief in feeding camps, may, especially when provided for too long a period, become a policy disincentive to a government and may even affect local market prices in cases where moderate integration of food markets exist.

As we have seen, a number of needy countries, dependent upon but too poor to pay for imports, can be identified. Many of these countries have high population growth rates, declining land arability, and threats to their forests and other ecological systems. In this context, the United States, as a world leader, especially in food aid, should provide leadership in addressing these problems, targeting its commodity aid to those countries where it is most appropriate. Unfortunately as tables 1 and 2 made clear, a high fraction of United States aid goes to certain countries with modest nutritional needs, while a smaller fraction of U.S. food aid goes to countries with high population growth rates and lagging agricultural production. Fortunately, these countries often get a sizeable portion of their aid from other donors, but this gives little credit to the

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U.S. as a "leader" in the food aid regime.

IV. PRESCRIPTIONS: TARGETING FOOD AID TO ADDRESS FOOD INSECURITY, ENVIRONMENTAL AND AGRICULTURAL PRODUCTION PROBLEMS

In light of the above analysis, it would seem appropriate for the United States to resume a more active leadership role in the food aid regime. Having established the initial principles and rules under which food aid became an institutionalized mechanism in international trade (Hopkins, 1987), the time is right for the United States to provide new leadership in shifting the world's attention to priority needs, in areas where the use of food is most appropriate and most efficient, and to setting an example in its own behavior so that food becomes delinked from agricultural subsidy and protection policies. This will allow it to be managed in a way that would be more likely to induce policy coordination and increased food provision by other industrial countries who, unlike the United States, are not food or agricultural exporters.

To achieve this goal, five steps would be appropriate, taken by appropriate committees of Congress in modifying existing legislation most profitably in consultation and concert with the administration. These steps are: 1) establishing food needs as the principal allocation priority for food aid; 2) establishing modalities whereby needed tonnages of food aid, particularly for the most stressed populations and locales, currently heavily in Africa, would be protected from price fluctuations; 3) streamlining food aid to make it a fully grant program and one related to prospects for debt forgiveness (this is particularly important in countries where such a step is appropriate ini support of economic policies to stimulate development and cushion economic sacrifices required to enhance domestic investment and frugality); 4) policy coordination and co-financing should be enhanced among donors, and 5) projects that attack fundamental problems leading to food security, including high population growth, deteriorating soil and forested land and the waste of harvested grain should be given high priority for the use of the food aid resource in those countries where it is appropriately needed as as addition to the domestic food supply.

These prescriptions may more precisely be put forward as reforms to the existing PL480 legislation and implementation. The aim is to establish changes in the international regime, with new guidelines and rules for the use of food aid. I conclude this paper with these prescriptions.

The first proposed change, putting foremost the need to direct food aid imports to countries desperately short in domestic production and without adequate economic purchasing power in the world market, has an intuitive sensibility. After all, these are countries in which the need for food is undeniably large, while the commercial import option to achieve food security is blocked by national poverty and growing debt. These countries need to import food under any circumstances. The important thing is that the food should come in a reliable and responsive way to their needs which vary from year to year. This requires that other priorities, particularly diplomatic, commercial and bureaucratic ones, do not force the misappropriation of food for less efficient uses. Furthermore, inertia, built-in to the aid system through the older, multiple purpose, annual

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authorization view of food aid should not present quick responses to the changing needs for particular commodities and for different levels. Food aid regulations should be formulated in a way that stabilizes food supplies, while at the same time meeting one of the newer norms of food aid provision, as stipulated in the Bellman Amendment of 1979, namely to prevent harmful damage to local markets. Following this scenario the top 10 countries for U.S. food aid would not include India, Egypt, Pakistan, Philippines, El Salvador, the Dominican Republic, and Morocco, states where the U.S. is the dominant provider. Not surprisingly, in more needy states, the U.S. contribution most often falls substantially below its average share. Allocating the proportion of appropriated dollars for food aid, assuming a base of at least a billion dollars for grant food aid (to which transport and and ancillary costs of an additional one to two hundred million dollars must be added) the allocation of such funds should be substantially redirected towards countries with high rates of environmental threat, malnutrition and high popoulation growth such as Ethiopia, Mozambique, Sudan, Bangladesh, and a number of other smaller African states.

Since Africa poses a special problem, and since price fluctuations are likely to be substantial in the 1990s based on a high probability of exogenous shocks to the market during this period as well as the rapid deterioration of the high world cereal stock levels of 1985-86, a second recommendation is to provide stability in food resources targeted to the needy countries and peoples in Africa. This could be linked to development oriented undertakings aimed at improving food production and protecting the

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environment. The creation of a special earmarked account for Africa would be similar to subminimums already used in the Title II legislation. If food aid were given a high priority to be allocated on a food security basis, then generally the need for a special earmarking for Africa would not be necessary. In reality, however, an African subminimum, added to the existing minimum tonnage requirements, would guarantee food for Africa and reduce the prospect that people in the world's poorest countries will have to disproportionately share the costs of instability in world food markets in the 1990s.

The third recommendation is to redraft the authorizing legislation so that AID may administer an entirely grant program dedicated to development. Food aid would go to those countries where food can be a valuable resource in attacking the particular problems associated with food insecurity and hunger, namely pressures on arable land and rapid environmental deterioration.

Fourth, in rewriting the legislation Congress might provide incentives for other countries to coordinate and cooperate in overseas undertakings using food aid with the United States. This would be desirable in order to raise world levels of food aid. The numbers forecasted as needed in the recent National Academy of Sciences workshop were double the aid currently available. The recommended steps should encourage donors who are not exporters, such as Japan, to find an untainted leadership and partner in working with the United States and utilizing U.S. farm commodities in their food aid programs. Such a step would put the United States in a much stronger posture vis-a-vis our own preference for a

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liberal trading order. The Uruguay Round of trade negotiations approaches the issue of agricultural trade barriers with considerable inconsistencies in the U.S.'s own program.

A fifth and final task is one which also might appropriately be attached to legislation, much in the way of the Bellman Amendment that requires the Secretary of Agriculture to affirm that any food aid provided will not adversely affect local production or national/international marketing. Such an amendment would require that priority be given environmental concerns such as improved and more efficient agricultural techniques. If food aid allowed recipients to exploit less heavily the marginal soils of Africa and to protect the environment more generally, its allocation would be given high priority among the projects financed by the U.S. Furthermore, such uses would be especially attractive for co-financing with other countries, possibly under the aegis of the World Bank which already is encouraging such steps. Particular projects, such as food for work programs, might receive food from the U.S. and food and cash from other donors. Currently, projects developed using food aid are widely scattered geographically and functionally; they are seldom integrated into national food needs linked to food production and distribution of the recipient country. This is especially true in mother-child health clinics and institutional feeding, though this type of project could be adapted to a food/population/environment policy context. U.S. priority for food security might have a stronger appeal to the economically sophisticated leadership in the aid community, certainly the Japanese.

The United States remains the world's largest exporter of grains, the

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largest provider of food assistance, and the most complex policy implementator. Legislative policy amendments, often create undesirable constraints and complex configurations for poliyc implementation. They can even create disincentives within the bureaucracy to accomplish tasks. As such they are often a source of amusement and scorn among political scientists. Although Congress has often been successful in earmarking specific projects or in initiating higher standards for environment and industrial performance, its efforts have inconsistent effects. Rather than streamlined, more efficient management resulting, often more complications built into the authorizing legislation, food aid or PL480 legislation, for example, result in net opposite results than intended. Title III is a case in point, I believe.

The above recommendations are closely linked to the farm bill which will be under discussion in 1989. Returning to the initial recommendation, namely that food aid should go to poor countries most in need of food imports to meet nutrition deficiencies, such need should become the principle priority of food aid. It might be appropriate next year for Congress to add, by way of a preamble to PL480, the desire that the principal aim of food aid should be to attack the very conditions and causes that bring into existence a high need for food aid. These would be, most centrally: (1) the need to improve agricultural production through practices that do not threaten the environment and which take advantage of the latest technology; (2) the establishment of regional and national markets to smooth out instabilities in domestic food supply and reduce the need for food imports in the longer term under grant conditions, and (3)

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the design of experimental interventions, perhaps using food-for-work, in which other donors would provide co-financing with the United States to reduce as directrly as possible the causes of high population growth rates. Fundamentally, the policy imperative must be to use food aid to attack the explosive and dangerous conditions of urban populations and the increasingly vulnerable and less fertile production practices arising from pressure to grow more food.

V. CONCLUSION

This is a period of turbulence in international affairs. Its cause, in part, is the declining capability of the United States to manage global problems, including ones arising from and related to population growth and threats to the environment. It is crucial that the United States reestablish leadership in reforming the work of the international community to tackle these problems (Rothstein, 1987).

Specific reforms in U.S. legislation and executive branch practices that would enhance our country's ability to address positively the problems created by growing population, and the associated stresses of food deficits and declining agricultural efficiencies have been identified by many scientists. In particular, a first step is to mandate that priority be given to addressing food insecurity and the interrelated nexus of threats to the environment and agricultural production. Marginalized populations that emerge in countries in which food insecurity is most chronic pose multiple threats to U.S. and world iinterests. Second, special protection for countries whose needs are projected to rise in the 1990s, principally

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in Africa, is appropriate, perhaps through providing for minimum tonnage guarantees to such countries, in addition to the current minimum tonnage the legislation mandates for the private voluntary organizations and World Food Program. Further, greater flexibility in the programming and delivery of food should be permitted. This is particularly important for countries where production variability is high, transportation opportunities change seasonally, and national-level adaptive capability is low. The U.S. might adopt the European Commission's practice of allowing a two year period for meeting annual authorization levels. Third, the use of food aid as a mechanism for commercial competitive advantage should be curtailed. Although this is an important and legitimate interest of the United States, combining it with our economic assistance detracts from the integrity of our international posture as an aid donor and is construed by other countries, on occasion, as hypocritical. Certainly it contravenes the norms of free trade and the U.S. goal of reduced agricultural trade barriers (which has been a central position of the U.S. in current international trade negotiations). Finally, the United States should take leadership in developing food aid projects that directly attack the underlying conditions that foster food insecurity and the problems associated with it, such as rapid population growth. We should pay particular attention to the problems of rapid urbanization in developing areas both because this will improve political stability in such countries and because it will reduce pressure leading to environmental problems. Such efforts should be regarded as highly favorable even though the discounted rate of economic return on investment in such projects would be

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lower than investments in high potential projects.

With such an emphasis, I believe, the prospect for co-financing with other donors who could provide both cash and food inputs to longer term efforts seems promising. The World Bank has begun efforts to initiate a framework for such cooperation and significant donors that are not food exporters, such as Japan, have exhibited a willingness to associate their financing when such efforts are not competitive with their own domestic industries.

The broad proposal outlined above is for reform of the international food aid regime. The United States was its principal founder and major contributor both to its substance and its rules and regulations which have evolved since the 1950s. An appropriate role for the United States Congress and the executive branch would be to reassert leadership in this realm, taking advantage of America's rich agriculture productivity and surplus capability, along with our deep concerns for the global environment and for efficient agricultural production, to direct the use of food aid more centrally toward the goals of protecting people and protecting our environment.

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Mr. **Scheuer**. Thank you very much. All right, Dr. Charles Benbrook. I guess I introduced before, Chuck. Executive Director of the Board on Agriculture at the National Research Council, former Staff Director of the House Subcommittee on Department Operation Research and Foreign Agriculture of the House Committee on Agriculture. We are delighted to have you here, Chuck. Please take your five or six minutes and chat with us.

STATEMENT OF DR. CHARLES BENBROOK, EXECUTIVE DIRECTOR, BOARD ON AGRICULTURE, NATIONAL RESEARCH COUNCIL

Dr. **Benbrook**. Fine. Mr. Chairman, thank you very much. I am really pleased to have a chance to participate today. You compelled me think about a set of issues that I don't normally, and I know that your scheduling these hearings and putting so much of your own energy in them reflects your deep concern about this set of problems, and indeed, they are very perplexing, and it is an appropriate time in the United States to be thinking anew about how to approach them.

One of the things I did in getting my thoughts together, Mr. Chairman, was to review the well-known 1977 National Academy of Sciences report on World Food and Nutrition. You no doubt recall the World Food and Nutrition Study. One thing I suggest that the committee undertake as an analytical contribution to your subcommittee report that will be shared with the Parliamentarians this fall is to take and develop a list of the principal recommendations in the 1977 Academy study and do an analysis, at least a brief analysis of those recommendations that have been acted upon, those which have not, which ones worked and which ones didn't, because that exercise reflected in—

Mr. **Scheuer**. Which ones look still very promising—

Dr. **Benbrook**. Exactly.

Mr. **Scheuer**.—that haven't been implemented.

Dr. **Benbrook**. And the reason that I make this suggestion, Mr. Chairman, is that in looking back over the volume and the work that went into it, this was an enormous intellectual exercise. Many of the issues have not changed that much, only grown more pressing. And it will astound you, the language used in that report, because it could be written today and be equally meaningful.

I would like to point out one thing for you and the subcommittee. You do include in your jurisdiction agriculture research in this country, and I did review the specific U.S. research recommendations in the 1977 Academy Report, and I would offer these three observations.

First of all, the principal substantive recommendations have yet to be acted upon. The research recommendations could be written today, and if acted upon would be just as meaningful as then. I say this in particular with respect to the need, what we need more knowledge for.

I would say, Mr. Chairman, that the scientific opportunities have changed very dramatically since 1977. We have opportunities now to apply new scientific tools, new knowledge about modern production agriculture, about the ability to manipulate genetic characteristics that fundamentally alter both the kind of science and the benefits that can flow from new research directions. So while the need hasn't changed, the kind of science that would be undertaken has changed, and I think very much to the better.

Last, I would like to alert you to a very important and exciting activity that the Board on Agriculture is involved in at the present time. We are developing a report and we will be releasing it later this spring calling for a $500 million increase in the USDA competitive grants program. We are calling for both a major increase in funding and a major programmatic reshuffling, if you will, expansion of the focus of research under the competitive grants program, and I was both pleased and a little surprised when I read the 1977 NAS report to see a recommendation that called for such an expansion in the competitive grants program with a lot of the same language in a draft of the report that we wrote only last week.

So there will be, I guess, another opportunity to try to engender political support for this kind of change in U.S. agriculture research priorities.

Mr. Chairman, you gave me a difficult assignment in trying to think through some of the questions about agriculture production capacity and research, and I would like to share with you what, to the limited extent of my knowledge, I can say. And it does put a bit of a different perspective on the issue, particularly from the perspective of the ability to produce the food. First of all, it is my judgment that the world has the capacity, the resources and the technology, to substantially increase food production in the near term and produce enough calories, if you will, to substantially alleviate much of the chronic malnutrition that exists around the world. I think that the capacity is there.

[The prepared statement of Dr. Benbrook follows.]

PRACTICAL REALITIES AND POLITICAL OPTIONS IN OVERCOMING WORLD HUNGER

Invited Testimony by
Dr. Charles M. Benbrook*
Board on Agriculture, National Research Council

Mr. Chairman, I am delighted to have an opportunity to participate in these important hearings on the world food-population balance. I will try to respond, at least in part, to the difficult questions you have raised in your letters of invitation. My comments and conclusions this morning reflect my own thinking, and are not based on reports of the Board on Agriculture or the National Research Council (NRC).

It is regrettable that the NRC has not had an opportunity since our well-known 1977 World Food and Nutrition Study to carry out an in-depth assessment of the scientific, economic, and institutional issues associated with world hunger. Several units of the NRC, including the Board on Agriculture are eager for a chance to undertake a contemporary analysis of how to enhance the world's capacity -- and will -- to turn the tables on world hunger.

The Academy's 1977 report was a landmark. It came in an era of strong growth in U.S. agricultural exports, an era characterized by growing concerns about population growth and resource limitations. In the early 1980s, the agricultural policy agenda in the developed world shifted swiftly to fixation with the consequences of surpluses: the cost of subsidies, farm financial stress, trade conflicts, and rural decline. Today, agricultural leaders are uncertain whether we are three months away -- and four good rains -- from a return to ample, if not excessive supplies, or perhaps in the event of another drought, about to enter an era of food-driven price inflation and severe food shortages. Less than a year ago we had record volumes of grain in storage worldwide, and now we are perilously close to finding the bottom of the barrel.

Progress since the 1977 NAS Report

Mr. Chairman, I would urge the subcommittee to include in its hearing report a synopsis of the major findings and recommendations of the 1977 NAS report, followed by a brief analysis of the extent to which each major recommendation has been acted upon and proven effective.

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* Dr. Benbrook is Executive Director of the Board on Agriculture, National Research Council. Testimony presented February 28, 1989 before the Subcommittee on Natural Resources, Agriculture Research, and the Environment, Committee on Science and Technology.

By assessing both the positive developments and disappointment following release of the 1977 NAS report, the subcommittee will gain important insight into the complexities of the problem and the great difficulty of fashioning a meaningful international response to this problem. To facilitate the subcommittee's review, I attach a copy of the 1977 NAS summary report World Food and Nutrition Study: The Potential Contributions of Research.

The 1977 NAS report contains several important recommendations for U.S. research. Mr. Chairman, in light of the subcommittee's long-standing interest and jurisdiction over agricultural research, three key points relative to these recommendations warrant mention:

- With few exceptions, the 1977 report's research recommendations have yet to be acted upon.
- The key areas of need have changed little since 1977, although the scientific opportunities have changed dramatically. Indeed, the biotechnological revolution in agriculture could profoundly alter the tools mankind can bring to bear in finally bringing food production capacity into balance with need on a sustainable basis.
- The NRC's Board on Agriculture is currently completing an important report calling for a $500 million increase in U.S Department of Agriculture competitive grants. This major change in agricultural research programs designed to draw more of the nation's best scientists and engineers into research responsive to key contemporary needs, many of which were also highlighted in the 1977 NAS study.

Contemporary Realities

Previous witnesses have no doubt fully documented the fact that hunger and malnutrition persists in the world today. Hundreds of millions of people would live longer, healthier lives if they had access to more calories, and a higher quality diet.

Is it technically feasible for the world to produce enough additional basic foodstuffs on a sustainable basis to provide a higher quality diet for those now suffering chronic malnutrition?

Absolutely yes.

Is the underutilized productive capacity of U.S. agriculture important if the world community is to seriously tackle hunger?

Definitely yes. Because of our idled land, underutilized infrastructure, technology, and human skills, the United States accounts for much of the world's readily accessible capacity to quickly expand production. Moreover, the United States could increase production without major increases in commodity prices, or investments in infrastructure, human skills, and technology. (I would consider a 25 percent increase in prices at the farm level "major.")

Can the United States expand its production without accelerating the pace of resource degradation and exacerbating environmental problems?

Clearly, resource conservation systems and technology exist that are well-proven and economically viable. They need to be used more widely throughout American agriculture. This need will intensify if the nation enters a new era of rapid growth in exports and production levels, whether driven through commercial sales or food aid. It is clear, however, that farmers have access to technology and management options that would allow levels of production to rise without a marked increase in adverse impacts on the environment or resources.

How do agriculture-environment-natural resource problems in the United States compare to other developed countries?

I believe this is a key question for the subcommittee to consider. In my opinion, the United States is years ahead of most other major exporting nations, particularly those in Europe, in dealing with soil erosion, non-point water pollution, safe use of agrichemicals, and the need to balance agricultural production and environmental goals. Evidence strongly suggests that several European nations will have to confront water quality problems in the 1990s of much greater severity than those likely to persist in the United States.

It is true several European countries have adopted, and are moving toward very aggressive policies to deal with agricultural sources of pollution. But it is also true that there is a compelling need to take such actions because of the proximity of people and farming operations throughout much of the European continent.

What about the severity of natural resource problems in the United States in contrast to food-short developing countries?

Here, the answer is depressingly obvious. Many developing nations face an almost impossible task in even slowing down current alarming rates of erosion in the productive capacity of natural resources. Erosion, desertification, water-logging, salinity, and the loss of species will be very difficult to reverse in countries facing the twin plagues of population growth and poverty.

Attempts to increase production in developing countries through importation of developed-world chemical and capital intensive technologies are likely to fail on economic and technological grounds. Moreover, these technologies can add dangerous new dimensions to cycles of natural resource degradation, and set the stage for a new generation of environmental problems including water pollution, wildlife poisonings, and human death and disease.

The scientific, institutional, and human capacity to overcome natural resource and environmental problems is much more nearly in place in the developed world than most developing countries. It will take generations to close the gap, and an unprecedented degree of cooperation and vision among the world's multinational institutions and political leaders.

However, principles of sound fertility and pest management, diversity, and resource conservation can vastly improve the long-range productivity and viability of food production in many developing regions of the world. Many examples could be cited. Nonetheless developing nations have often fallen into hunger due to a very complex collision of unpredictable circumstances such as war, insurrection, revolution, population growth, national debt, etc., all of which tend to put great pressure on the natural resource base. It is wrong to assume, however, that most developing countries are doomed to hunger. Given proper economic incentives and assistance, farmers in most countries in most years are generally capable of producing more good than can be consumed locally.

Distributional Problems and Political Constraints

The world can produce enough food to substantially eliminate hunger. The world is now annually spending between $150 to $250 billion directly on agricultural trade subsidies, tariffs, fees, quotas, and agricultural income support payments, or indirectly through higher food costs than necessary if borders were opened to supplies available in world markets. If a portion -- say 25 percent -- of this investment necessitated by contemporary global policies and geo-politics could be redirected toward food aid, the world community could without doubt seriously take on the production side of this great challenge. Some novel approaches to accomplish this goal could conceivably be considered as part of the current GATT round.

But what about getting the food to the people who need it? Are we destined to repeat the failures of the past?

Many people who have dedicated their professional careers to the world hunger problem have grown extremely skeptical, if not down right hostile to the concept of food aid. (See for example "Less Food Aid is Better," by Larry Minear, Bread for the World, Washington, D.C.) The problems are well-known:

- Lack of roads and infrastructure.
- Political corruption and using food aid as a weapon in ideological or economic struggles.
- Undermining local incentives to increase food production.
- Unreliability of developed world commitments; mistrust of motives.
- Tendency to encourage increased population growth, thereby worsening future problems.

These problems surely stand in the way of effective food relief efforts in some parts of the world. But they do not in others. The problems are very different, for example, in getting food to the growing masses of people in and around major cities. It seems to me there must be ways to identify areas and opportunities to overcome past problems with new approaches to food distribution. Perhaps past successes, and failures can serve as models in shaping future efforts.

Opportunities to Turn the Table on Hunger

While the developing world works through debt, educational, and economic development challenges in the decade ahead, the only way major near-term progress can be made in relieving hunger on a global scale is for the developed world to produce and ship more wheat, rice, corn, and beans into food deficit regions of the world. This is a necessary, but not sufficient condition. Distributional hurdles would still have to be overcome. I simply see no other way for major near-term progress to occur, short of a rapid decrease in population levels in chronically food-deficit regions. In the long-run, the world could pursue a wider range of options, tailored to the unique needs and opportunities in different regions of the world.

How can the world community realistically deal with hunger issues in the 1990s given contemporary geo-political and economic trends?

To succeed, the effort must be multinational and non-sectarian. Financial support from the developed world must be strong, sustained, and largely free of politics.

Hunger problems must be addressed, indeed solved as part of international efforts to deal with debt, economic development, and trade issues. The GATT process has great significance since its success in removing trade barriers will determine whether the developed world must continue investing hundreds of billions in trade and income support policies that increase the cost and reduce the supply of food.

GATT is critical for a second reason. Many developing nations desperately need more favorable access to developed world markets. This access is most important for value-added products that are so key to economic development and diversification. (This is equally true in many rural areas of the United States.) Economic growth, in turn, is necessary to retire foreign debt, improve farm markets and prices, and slow down pressure on fragile natural resources.

In the United States, one of the great successes of the 1985 farm bill evolved from a set of innovative policies linking commodity program incentives for agricultural production with farm management decisions consistent with stewardship goals. Limited federal dollars were leveraged by a new set of policies that replaced inconsistent program provisions with new provisions that reinforced desirable on-farm behavior.

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This model warrants consideration in thinking through novel opportunities to link GATT, debt relief, efforts to deal with global environmental problems, and food aid issues. If time allows during the question period, I would be glad to share some more specific thoughts in this regard.

U.S. Actions and Congressional Challenges

Mr. Chairman, the U.S. Congress is likely to pass several pieces of legislation in the 101st Congress of direct relevance to the issues before the subcommittee. In closing, I would like to merely alert you to some of the most significant:

- Reauthorization of the Foreign Assistance Act.
- The U.S. AID appropriations bill, and the need for Congressional support for AID's emerging interest and commitment to sustainable agriculture. (A recent NRC report on this subject to the AID Research Advisory Committee is attached for the subcommittee's record.)
- The proposed reorganization of AID.
- The 1990 or 1991 farm bill, and the need to extend the progress made in the 1985 act in the area of soil erosion control to other stewardship challenges, particularly water quality protection.
- Trade legislation may begin to take shape in this Congress if the GATT round leads to some concrete resolutions of long-standing controversies.
- Amendments are bound to arise again attempting to restrict the flow of U.S. agricultural technology to developing countries which are or may become competitors.
- Legislation relative to debt-relief and/or the U.S. contribution to the World Bank and United Nations may offer opportunities to help develop needed institutional capacity in the areas of agricultural production, nutrition, resource protection, and food distribution.
- The Board on Agriculture's major agricultural and food sciences research initiative may come before the Congress, and would, if adopted, constitute a significant, tangible action in response to the research recommendations in the 1977 NAS World Food and Nutrition Study.

I thank you for the opportunity to share these thoughts with you this morning. The Board on Agriculture and the NRC hopes to have an opportunity in 1989 to initiate a new world food study. We hope to have an opportunity in the near future to discuss our long-standing interest in this critical issue with the new Secretary of Agriculture, Mr. Clayton Yeutter.

Secretary Yeutter has a deep appreciation of the linkages of agricultural income, trade, and development policies. He also shares with nearly all American farmers a sincere eagerness to find better ways to more fully use America's wealth of natural resources and human talents to get on with the job of growing food to feed people. It is, indeed, a profound tragedy in this modern era of technological miracles that mankind remains so far removed from satisfying this most basic of human needs.

Mr. SCHEUER. Is the capacity there now or is the capability to produce that capacity there now?

Dr. BENBROOK. No, I would say that much of the capacity is in place. The next critical question I would address is, is the underutilized production base of the United States important in this near-term capacity, the increased production. And I would answer that, yes, it is very important. We, until 1989, have been holding about 30 percent of our productive land base out of production in this country for much of the 1980s. The problem of chronic surpluses and depressed prices has led throughout this decade to a change in investment in American agriculture from increasing productive capacity to sustaining near-term farm income. As a result, we have basically a tremendous amount of underutilized infrastructure that could be put to the task of producing food if there was a market for it. Obviously, the capacity of this country to increase production on a sustainable basis is subject to the degree to which farmers adhere to the sound conservation principles and deal with this country's at times and in some areas very serious environmental problems. That is another important question that I will address in a moment.

One thing that I think is very important for you to bring to the Parliamentarians this fall is a sense around the world, if we are going to substantially alleviate world hunger, how is it feasible to do so, and basically, Mr. Chairman, I think that the United States has more capacity than any other country and region in the world in the near term to do that. I think the European continent has much more severe and serious environmental problems facing its agriculture, largely because of the very high internal prices. Farmers in Europe are using much more intensive methods, much more high cost production practices than currently in much of the United States. And as a result, the environmental problems that are emerging in Europe really make ours pale by comparison. My sense of the capability of many developing countries to reverse the declining per capita food consumption aggravates the trends of resource degradation as people are moved out onto more marginal resources.

I find that whole picture very disturbing. I think that at best, we might be able to slow down the rate of natural resource degradation, but imagine a scenario of the technology and the knowledge and the production capability to emerge in the developing world fast enough to get ahead of population. I just don't see how it is going to happen.

Mr. SCHEUER. Well, now, isn't that a little bit in contradiction to your opening statement that we have the capability of feeding the peoples of the earth?

Dr. BENBROOK. Well, no. I think that the developed world is holding out a lot of agricultural infrastructure that is there, that productive capacity could be brought to bear and make a contribution to the global supply of food, if all the distributional and economic and north-south problems could be resolved. There certainly is not, on the other hand, much unused productive capacity in food deficit regions of the world. It is not there. So there is a mismatch between where the food is needed and where it could be produced. I think that this mismatch, Mr. Chairman, is going to continue to draw apart, if you will, and so if it is the policy of the world community to not expand food aid, to back away from food aid, then really what we are doing is enforcing the Malthusian arithmetic on each country or region of the world. I think the consequences of that are quite grave.

Mr. SCHEUER. Well, I think you could put another interpretation on it. We are going to hear from Maurice Strong, who was the first director of UNEP, after this panel, and he is quite an expert on international aid of all kinds, but from my knowledge, no country has benefited more than 15 or 20 percent of its economy from foreign aid and 80 or 85 percent of its development has to be fueled from within. I think that is more or less the history, and if I am wrong, please tell me. Now I don't see any evidence that the developed world is going to be willing to have a continuing transfer of resources, food resources and capital resources that will be growing gradually larger every year until the end of time, to feed a burgeoning Third World population that is increasingly food un-self-sufficient.

I think there are a small group of enlightened people in most of the countries of the developed world who wish we would do more, but as a realistic matter, I think over the long term, Third World chiefs of state, I think, have got to come to the conclusion that they have to achieve an equilibrium between their people and their food production capability. Any other conclusion, I think, would be really quite unrealistic, and most of the experts who have looked at it seem to feel that without some kind of well-thought- out population program that would moderate population growths from the point of being over 4 percent a year, which gives you about a 16 or 16.5-year doubling period, that if those population growth rates can't be moderated, then I see little hope of getting on a sustainable basis food from the outside at a scale that would double every 16 or 17 years, as well as getting them aid that would help them double their infrastructure of schools and teachers and hospitals and doctors and nurses as well as jobs.

There is a scarcity of 800 million jobs in this world between now and the end of year. We should be developing 800 million jobs, according to the International Labor Organization. That is more than the entire working population of the developed world. It's not going to happen. You have 50 percent unemployment rates endemic in the Third World. I think to set a goal that the developed world will establish long-term food aid policies that will feed Third World populations at their current exponential rate of population growth is just wishful thinking and really deters one from facing up to the real problem of how we help Third World countries achieve equilibrium over the long pull, how we'll help them achieve that goal, whether it is 5 or 10 or 15 or 20 years from now. How do they achieve equilibrium themselves within their own countries between food production and people production, between growth of food and growth of population?

You know, up to 30 years ago every single country, I think without exception, in sub-Saharan Africa was a food- exporting country. Today almost every country in SubSaharan Africa is a food-importing country, and therein lies the nub of the problem.

Look, I didn't mean to take off on this situation, but I think our focus has to be on not how we can help them with a fish today, and I am sure you are all familiar with that biblical allegory, but how do we teach them how to fish? How do we help them achieve sustainability in food and people by agricultural practices that are themselves environmentally sustainable, so that they don't wreck the resource of their own land and their own water and other resources?

Let me ask you all a question that I have suggested before, and that is, the effect of—and to Maurice Strong back there in the corner, going off the record.

[Discussion off the record.]

What has been the impact of the pressures on developing countries to repay debt? What has been the impact on their social—their health, their welfare programs? How has that produced, if it has, pressures on them to engage in unsound and unsustainable programs for raising food?

Lester Brown mentioned too much pumping, too much plowing, bringing land into production that shouldn't be into production, eroding the water table, too much insecticides, too much pesticides, too much fertilizer, that the planet cannot sustain without degrading the very resource, namely, our land, that produced the food in the first place.

I don't want to put words in your mouth, and if the situation isn't as bad as I fear that it is, please tell me, because we are looking to achieve some kind of new approach to Third World debt that will not put Third World countries permanently on the dole—that's not viable and doable either—but that will make some kind of arrangements for Third World debt. And you have heard the phrase "exchanging debt for nature", that helping Third World countries cope with their debt, maybe in stretching it out, thinning it out, whatever, reorganizing Third World Debt, with also increased equity investments, increased loans, increased technology transfers from developed countries, so that gradually the Third World can develop the economic infrastructure as well as the agriculture infrastructure to support their populations in a minimally acceptable fashion and to begin to support their own debt and finance their own debt as they are able to place additional debt in the future.

Did you want to say something?

Mr. BROWN. Yes. I just wanted to respond to that question. The implications of the question may be somewhat more serious than your elaboration implies. There is no question in our mind at the Worldwatch Institute that a way has to be found to reduce Third World debt to a level that will permit the restoration of economic progress. What we had hoped would happen in developing countries is that improving economic and social conditions would lead to smaller families, and that is the basic part of the demographic transition. What, in fact, is happening, as earlier witnesses have reported, is that the reduction in health care and education, et cetera, is not contributing to the sort of natural, if you will, reduction in family size. And as a result, population growth continues to be rapid and is beginning to degrade and destroy the resource base in a way that is becoming self-reinforcing, that is, more rapid population growth leads to a deteriorating resource base, and that becomes a self-defeating cycle.

What we suggested in "State of the World 1988," a year ago, was that a debt retirement fund be set up, one that could be managed jointly by the Bank and the Fund perhaps and that countries—and that the initial capital infusion might come from the Japanese, sort of the late twentieth century Marshall Plan, if you will. That fund would be in a position to buy in the market the discounted debt of Third World countries and would do that after a country had devised a sustainable development strategy dealing with things like deforestation, soil erosion, population growth, renewable energy, energy efficiency, the package of things that we now know are the basic components of sustainable development. And if a country were to come up with that sort of a plan and would be politically committed to it, then in exchange for that, its debt would be reduced. Let's say Peru has $20 billion worth of debt, and it can manage $8 billion but not $20 billion, then the fund would go out and buy at 20 percent—or whatever the market rate is—$14 billion worth of debt and reduce it to the point where they could begin to manage it and move ahead.

Unless a commitment is made to sustainable development, there is really not much point in dealing with the debt issue, because the country is going to go down the drain anyway.

Mr. SCHEUER. Or the food issue, for that matter.

Mr. BROWN. Which has to be part of it.

Mr. SCHEUER. Or any issue, for that matter.

Mr. BROWN. Which has to be part of it, yes.

Mr. SCHEUER. It has to be part of it, and if developing world countries can't muster the will and the determination to get their economic act together and have an engineered timetable that will lead to a sustainable society and a sustainable economy, I don't know that there is any way that the outside developed world can really help them, absent that will and determination among the leadership of that country.

Am I wrong? Am I too harsh with this point of view?

Mr. BROWN. No. The reason for recommending that the debt retirement fund that we were suggesting operate in this way is that sometimes, in fact, oftentimes, political leaders want to do some of the things that need to be done but do not have the support to do it. I mean, we should be raising the price of gasoline in this country right now, but we are not doing it. What the debt retirement fund would do would provide—

Mr. SCHEUER. I will say this. Congress and the Executive Branch may be behind, not only behind the clear needs but even behind public opinion. When Time magazine in that issue on the environment comes out for a 50 cent per gallon tax which would produce $50 billion a year—and Time magazine is not a journal that appeals to 1930s, ADA, knee-jerk liberals, it is a centrist magazine that has a broad-based acceptance in the American public. When they come out for a 50 cent a gallon gasoline tax, it seems to me we all have to think that there's a new perception out there of the need to face up to not only doing something about our trade deficit and our budget deficit but also doing something about the profligate wasteful, irresponsible way we are using valuable energy resources.

It is no secret that the Germans, the Japanese, the French, the Swedes have developed a car capable of going 80 to 100 miles a gallon, 80 in the country and 100 in the city. And the reason why American manufacturers can't do that, and they are perfectly honest in telling you, is that when we price gas at $1 a gallon compared to the way Europeans countries and Japan, Australia and New Zealand price gas at $2.50 to $3.25 a gallon. When we price gas that cheaply, it encourages people to use it in a cheap and profligate manner, and there is no incentive to them at those prices to economize on gas. So as a result, our rate of energy efficiency achievement is deteriorating and the wastefulness of the way we use gas and other critical resources is increasing.

So it seems to me that you really hit the nail on the head.

Mr. **Brown**. Let me just tie the two points together.

Mr. **Scheuer**. Yes.

Mr. **Brown**. What the debt retirement fund could do for developing countries is what OPEC did for us 15 years ago on energy efficiency.

Mr. **Scheuer**. Yes.

Dr. **Hopkins**. May I respond also?

Mr. **Scheuer**. Yes, please.

Dr. **Hopkins**. I see a big problem with what Lester Brown has proposed, not in the theory but in the practice. That is to say, a sustainable development strategy plan sounds right, intellectually, and exchanging that for debt forgiveness does provide resources for countries to use that they wouldn't have if the debt forgiveness were not available. The question is implementation, and particularly, we focused on Africa, and we know that unless the underlying political pressures and an underlying lack of human resource capabilities are addressed, many of these countries will promise anything, but not be able to deliver, not for lack of even good will at the very top but simply for lack of capacity in the internal structures of their countries.

Remember that the food security issue was very important in the 1970s and a number of African countries were told that if they would adopt a food security plan that they would receive additional resources, and the European Community did provide additional resources to a number of key countries, and in general, the assessments now done in the 1980s show that was a complete failure, because they had paper plans and no implementation was effective. So I would be very dubious about progressing without looking at the underlying institutional problems that these countries face, as well as the formal problems with debt. And one other point I would make on the debt. We all agree that food aid is not a solution or the old cliche about sustainable agriculture is what we need, sustainable meeting of the needs of the population and agricultural production within these countries to allow them to take care of their problems.

On the other hand, large-scale debt in the 1970s and '80s was a form of food aid to these countries. The actual amount of foreign assistance or food aid that was provided is modest compared to the actual amount of food imports that were effectively paid for through private or public financing. So when Congress looks at the issue of food aid, it should not fool itself by saying that we won't go ahead and feed people in the long run.

The United States, and this is where I agree with my colleague, Charles Benbrook, I think the United States is going to, for many, many years, remain a major source of food security for these countries, particularly in Africa. The only real question is on what terms. Do we give them away by debt? We let them borrow money from somebody else and import the food, or we put strings on it. We give them infrastructural resources. We target the food through a much more appropriate kind of focus, so that the food that is transferred will, in fact, impact on the kinds of problems we are talking about today.

Mr. SCHEUER. Let's talk a minute about the food security concerns that you have expressed and that Lester Brown expressed, and Lester Brown indicated that the gross imbalance between food and population can cause and has caused food riots, rural migration to food camps over borders, and so forth, and the same thing is caused by environmental degradation, which transcends national boundaries and causes problems among people in neighboring countries.

Can you specifically comment on the security implications of a burgeoning population and an increasing food deficit? What are the pure security implications, the potential for destabilizing stabilizing countries, regions?

Dr. HOPKINS. Well, my expertise is particularly in Africa—

Mr. SCHEUER. Fine.

Dr. HOPKINS.—although there are major problems elsewhere in the world.

Mr. SCHEUER. Joyce Starr talked about the Middle East, where you have got these countries living cheek by jowl with each other and how the desperate shortage of water in Jordan and Egypt and the Gaza Strip, with Israel's control of the River Jordan and a strategic position in the control of water resources has an immense potential for strategic problems of incalculable proportions.

All right. Let's hear from you on Africa.

Dr. HOPKINS. I think the key point is that people living in Africa, a good portion of it, are already so vulnerable that any disturbance in their society, environmental or military, civic unrest or so on, will lead to very severe consequences for the population. You see this in Mozambique, you see this in the horn of Africa. Right now in Ethiopia you have refugee camps set up to feed three different groups of people. One, people who are systematically being forced into starvation by the Ethiopian government because of their rebellion. Two, people being systematically forced into starvation and fleeing from the Southern Sudan by the government in Khartoum, and, three, people from Somalia, who are being systematically attacked by another group of people in Somalia and, therefore, fleeing into Ethiopia.

So you have three different groups of nationalities, if you like, or citizens, being fed through emergency programs, none of which have any forward long-term looking effects on how they are going to get out of that situation, and which under current Congressional mandate cannot be addressed in a developmental fashion because emergency food aid forbids it by the way it really operates.

So I would say, not only do you have food—

Mr. Scheuer. What forbids what?

Dr. Hopkins. It forbids the use of emergency humanitarian food aid to be used in a progressive and developmental fashion, by the very nature of the way in which the rules and regulations of that legislation have been drawn up and operationalized by A.I.D. And I find it appalling.

So you have a situation with terribly vulnerable people.

Mr. Scheuer. Would you elaborate on that a little bit?

Dr. Hopkins. Certainly. In Ethiopia, CARE proposed that where they had populations that had been in existence for three or four months in feeding emergency situations, they wanted to move them into sort of self-help situations, food for work projects, begin to rehabilitate them and get them to return to their home areas.

U.S. food aid was not made available to them when they requested it. Only European food aid could be used for food for work or food for adjustment kinds of activities, because PL 480 came to them as an emergency food aid. It had to be given away. If it wasn't given away, it couldn't be used. And we, under the current legislation and the current interpretation of the legislation, will give only humanitarian aid to Ethiopia, not developmental aid.

Mr. Scheuer. That is astonishing.

Dr. Benbrook. Mr. Chairman, I would like to raise two different concerns. One of the problems that we saw and we have seen in the last few years is the increase in flooding in many regions of the world. Much of the world's food supply is grown in lowland valleys, in coastal regions, where there is a combination of, you know, sunlight and water. Often these regions of the world are dependent on fresh water flowing down the great river systems of the world, but often they are largely productive with just natural rainfall, but what is happening around the world is that erosion in the hills and mountains that are being denuded of forest cover and grass cover by overgrazing, erosion is increasing and sediment is flowing down into the great river systems of the world and plugging up the drainage system of the major agriculture regions. And what is going to happen and what is happening now is that the frequency of major floods and the severity of major floods is going to increase.

I might note parenthetically that one of the predicted outcomes of global warming is not just warmer average temperatures but more erratic frequencies of major rainstorms. So we are going to have more severe storms and few nice gentle rains. Severe storms are the major cause of severe run-off, erosion and flooding. If it comes to pass, as in Bangladesh this past year, that some of the fertile producing regions of the world have, you know, 30 percent of the farmland with growing crops flooded out and a season lost, basically, this is going to be, I think, a major factor in the food security equation.

The second concern that I have is that food security is not just a matter of quantity, it is also a matter of quality. We have, I think, an emerging sense of dietary imbalance, nutritional and vitamin imbalance in the food supply that is available to people around the world, and this has to be kept in mind, plus the emergence of more and more evidence of severe human consequences from the presence of molds, chemicals, bacteria and other dangerous factors in food, because of the press of population, unsafe water and other factors. So I think that the inability of many countries to maintain the purity of the food supply and allow for it to be prepared and served to people in a safe manner, free of microbiological contamination and other hazards is certainly a problem that warrants consideration as well.

Mr. **Scheuer**. Well, I am going to ask this panel one more question, and then we will move to our last panel and hear Maurice Strong.

When you go to a Third World country and start talking about environment, sustainable agricultural practices, and so forth, you tend to hear two things. First, "you guys up in the States aren't so hot. You're degrading your portion of the planet at a far more horrendous clip than what you fear that we may be doing here. You've got your own acid rain; you've got your own Adirondacks lakes." They're pretty well-informed, some of them. Until you put your own house in order, you know, you really—don't come and preach to us.

And the second thing they hear is, "Besides, who do these natural resources belong to anyway?" They don't have very much of a concept of tropical rain forests and the black rhino and the elephant being a priceless global heritage for all mankind. How do we talk to them in a way that is acceptable to them, to try and encourage them to begin to live up to some kind of a global ethic on preserving the environment for the future of mankind? That doesn't ring very true to them most of the time.

How do we talk to them about the fact that the world is concerned with the preservation of the tropical rain forests in Brazil and in Central America and that we are concerned about the preservation of the black rhino and the white elephant, and that we are concerned with preserving our heritage of biological diversity, and we are appalled at trends that are taking place all over the developing world. Not entirely. We've got the same process going on in Hawaii, which is part of the developed world, but trends going on which, if they aren't interrupted, will destroy upwards of 20 percent of all living species, both animal and plant, by the end of the century.

But since our skirts are so unclean in the developed world, how do we convince the developing world that they ought to pay attention to us and ought to recognize that we are all surviving in this global village together and that we have a global concern with preserving their rain forests and so forth? Lester Brown.

Mr. **Brown**. I think, a couple things. First, we can encourage them not to make the mistakes that we have made. They can see what we have done wrong.

Mr. **Scheuer**. You know, they tend to say, you give us your sooty skies and polluted waters, because our environmental degradation is not sooty skies and unclean water, it is starving kids and disease and debt and infant mortality, and we will trade a lot of the price tags that you mentioned for development, for the benefits of the development. I have experienced that time and time again.

Mr. **Brown**. I think the key is that their future in the world their children will live in will be shaped by how they manage their environment. I mean, Brazil is a very live issue right now, as you know. And the key in Brazil is not necessarily what we want them to do with the Amazon. The key is what they ought to be doing with the Amazon for their own good. Their own scientists, Brazilian scientists, make it very clear that burning off the Amazon is not the way to ensure a prosperous future for Brazil.

The alternative to a rain forest in the Amazon over the long term may be a wasteland. We don't have to tell them that. Their own scientists know that very well.

Mr. **Scheuer**. Yes; of course.

Mr. **Brown**. And the question is, what is sustainable in terms of the use of the Amazon, and that is in their interest at least as much as it is in anyone else's interest.

Mr. **Scheuer**. Of course, it is.

Mr. **Brown**. I think it is the argument in terms of their interest that has to be made. Not only is the Amazon important in its own right, but in terms of the recycling of rainfall inland and its effect on rainfall and climate patterns in the southern part of Brazil, in Paraguay and northern Argentina, that key agricultural area in Latin America, if they want to protect their own agriculture over the long term, they are probably going to have to protect the Amazon to do it.

Mr. **Scheuer**. The problem is, that phrase, "the long term." We don't do so well in consideration of our needs for the long term, because of the pressures of the short term, and you have heard time and time again, American corporations aren't worried about 10 years or 15 years, they are worried about not only this year but this quarter. So again, here is a problem. And we talk about environment for the long term, but when the Japanese began to talk to the Brazilian authorities about financing a $300 million railroad to bring all that mahogany to the west coast of Brazil so it can be shipped right to Japan, they are fueling economic incentives that are so powerful that they almost always override concerns for the long term.

I guess it was John Maynard Keynes who said in the long term we will all be dead. Well, we will surely be dead if we let the short term overwhelm us and prevent us thinking about the long term. I don't want to be a defeatist. Let's us end up this panel on an upbeat note. Are you sure this is going to be upbeat?

Dr. **Hopkins**. I'll do my best.

Mr. **Scheuer**. Go ahead.

Dr. **Hopkins**. I agree the discount rate that economists talk about, as you recall from your undergraduate days, the long-term problem being discounted is at the very heart of much of the public policymaking today, in terms of our vision of the gap between what ought to be and what, in fact, is done. It seems to me there are two solutions. I see some hope in these solutions. The first is the growing understanding that I think Lester Brown was suggesting in the specific instances he mentioned in Brazil but could be translated into the broader context that people do have a growing awareness of the seriousness of these problems. I recall riding in a taxi in Boston this fall and asking the driver how he intended to vote in the election in November, and his response was, well, he hadn't made up his mind. His parents were both Democrats. He liked Dukakis, he said, but it would depend on Dukakis'position on the Brazilian rain forest.

Well, I must say that is the first time I heard a taxi driver bring this to my attention. I think there is some larger-scale polling data that suggests there is a broad, latent concern in this country, in Europe—the Green Party in Germany, for example, is good evidence of this, and also in some of the poorer countries of the world, for the environment. I think it arises from our greater understanding and education.

So the first point is, I think, focusing more education and understanding will change people's perspectives. We once thought the earth was flat; we no longer believe that. We once thought the air was ours free and forever, and we could do what we wanted. We no longer believe that. I think that change is real and could continue.

Mr. SCHEUER. That is very eloquent. I might say we had a hearing in this subcommittee four years ago about a project in Brazil in the Amazon, where they were clearing the Amazon, building roads, called the Polonoreste Project. And we had a day of hearings, and experts testified to us of the utterly aberrationally destructive characteristics of that project, how the land was being abandoned after a year or two, because tropical rain forest land really isn't very good farmland, and that they were wrecking the rain forests. They were abusing the Miskito Indians, and they were producing land that was virtually useless after a couple of years. The World Bank was encouraging all of this and financing all of this.

We wrote a letter to the Treasury Department representative on the World Bank, about a six-page, single- spaced typewritten letter, as I recall, summing up the hearings, along with the hearing testimony, and within 60 days, that project was stopped.

Dr. HOPKINS. That's very encouraging.

Mr. SCHEUER. Now wait a minute. I'm not finished.

Dr. HOPKINS. Oh.

Mr. SCHEUER. The point I am trying to make is, a) even a few Congressmen once in a while can make a difference, and b) every single witness that morning, the experts that I described, were Brazilian witnesses who came up here and testified. And they cared, and they were involved, and they were determined to stop this outrage. With a little partnership, you know, hands across the sea, we did it together. But it wasn't a question of the United States reaching down there and telling them what to do. Brazilian scientific and environmental leaders were reaching out for help over this environmental monstrosity that the World Bank was funding. So there was the leadership, and there was the concern, and it was really encouraging and heartening to all of us to see enlightened people standing up for the long term and the global village. It can happen.

Dr. HOPKINS. I agree completely with that model, and I think it is excellent. My second point really draws on that to a degree, namely, that we think of the environmental effects of individual behavior or even projects such as this, as having negative external effects which the people undertaking them don't have to bear. That is one of the reasons they go forward.

The only solution, it seems to me, is to change people's self-interested calculations, and people in Brazil or people in individual states and at the global level must recognize that if we are concerned about global degradation, then we need to put the burden of paying for these negative externalities on the individual people who are engaged in that. And that is requiring, essentially, whether it be user fees, taxes or other kinds of restructuring of policy, to make them pay or bear the burden of these damaging external effects of their behavior.

Dr. **Benbrook**. Mr. Chairman, to conclude on an upbeat note, that is what the U.S. Congress started to do with the 1985 farm bill in this country, and I am sure the process will evolve into some new areas of resource stewardship with the next farm bill. I think you can share with your colleagues, American agriculture is dealing with its environmental problems. Farmers have discovered a profound truth, and it is true here, and it is true around the world. A farming system and practice that degrades the natural resource base is one that is not economically sustainable. Good economics is good environmental stewardship, and you know, we have—I think we can offer the world an example of how we faced some of these problems and overcame them.

American farmers had the second record highest net farm income last year in history, and this year, it is going to be just a gangbuster. American agriculture is thriving right now, economically.

Mr. **Scheuer**. And is it thriving on a sustainable basis?

Dr. **Benbrook**. Yes. Virtually all of American agriculture is sustainable from a biological and resource stewardship point of view, and the areas where it is not have been well-studied and efforts are being made to try to turn around the production practices that aren't sustainable, and I think that they will be successful. I mean, the standards in this country of resource stewardship are very strict compared to virtually anywhere else in the world. And you know, I think American agriculture is going to do very well, and I think it is the example of resolving the need for production and the need for stewardship. I think it is a profound example for other parts of the world.

Mr. **Scheuer**. Well, you certainly did help us end up on an upbeat note. I thank this panel is a remarkably stimulating panel, and I wish we could go on all day. We had five Members of Congress here earlier this morning, but the press of events has lost them to us, and I wish they could have all heard your wonderful testimony.

Thank you very, very much.

Dr. **Benbrook**. Thank you.

Mr. **Brown**. Thank you, Mr. Chairman.

Mr. **Scheuer**. This panel is excused.

All right. We now have on the next panel a very distinguished citizen of the globe, Maurice Strong.

Maurice Strong is a name that is familiar to almost anybody who is concerned about the global environment and the integrity of our global development systems. He has occupied senior positions in a variety of international organizations, including the UN, the World Bank, the International Energy Development Corporation. He is currently Chairman and President of American Water Development, Inc., in Denver, Colorado, and he has received more honors, awards, citations, distinctions than I would care to rehearse at this present time.

I first knew him when he was the first chief operating officer of UNEP, of the United Nations Environment Program, where he set that agency on a course of great distinction.

It is a great pleasure to have you here today, Mr. Strong. Please take such time as you may need to chat with us, and I am sure we will have some questions for you after that. I want to apologize for the lateness of this hour. You have been inordinately patient. You were preceded by several very excellent panels. I hoped you enjoyed them. I wished that we could have arranged things a little more efficiently so you wouldn't have had to have been kept waiting, and I apologize for that. I thank you for being here.

STATEMENT OF MAURICE STRONG, CHAIRMAN, AMERICAN WATER DEVELOPMENT, INC.

Mr. STRONG. Thank you very much, Congressman Scheuer for that generous introduction and for this opportunity of appearing before this very distinguished panel and also, may I say, for your own—

Mr. SCHEUER. Could you suspend for about 62-1/2 seconds?

[Discussion off the record.]

Mr. SCHEUER. Okay. Please proceed.

Mr. STRONG. Well, I was just about, Congressman Scheuer, to pay tribute, very sincere tribute, for your own longtime continuing and effective leadership in the field of environment and related matters, and I am particularly delighted to be here this morning, and certainly, no apology is necessary. I was the one who had a hard time getting here this morning, and I have been amply rewarded by the very, very fine presentations we have heard this morning from the distinguished panelists. In fact, if we would stop right here, my own visit to this subcommittee would have been amply rewarded simply by sitting and listening.

You have heard a great deal, I think, about the problems related to the food population equation which is the subject matter of this hearing and some very interesting thoughts on possible solutions.

Now I bring to this hearing really the perspectives of an operator. I am not a student; I am not an academic; I am a farmer and a practitioner in the field of development, as you were good enough to say, Congressman Scheuer, and so I would like really to address more the question of solutions, and I gather I have about seven minutes or so, and I will try in that period—

Mr. SCHEUER. Well, since you're the last witness, why don't you really take what you need, if it's 10 minutes or 15 minutes. No problem.

Mr. STRONG. Well, I am kind of geared for the seven minutes, and I may spill over a little bit, but essentially, I am going to concentrate on a solution-oriented approach to this issue, too, because we are all very aware of the problems, and there are many, they are more complex than we ever imagined them to be. Experience has demonstrated how difficult it is to address them, and yet our present perceptions compel us to the conclusion that it is absolutely indispensable that we address them. This is a set of issues that is not going to simply manage itself and go away. There is no way. It is an issue that must respond now to imaginative and practical treatment on a scale we haven't even envisaged and a scale which you reminded us, Congressman Scheuer, is not very realistic to expect in the present political environment.

Now I am going to just touch on the problem side simply so you will know the context in which I am suggesting some approaches to solutions. You have heard it all this morning, and I think I am in basic agreement with much of what I have heard. The real problem is not any longer absolute shortages of food, but rather the deepening imbalances in the pattern of food production and consumption. Surpluses in one area and deficits in the other and the countries that have surpluses are largely the rich countries and those countries also have the capacity to meet any possible future deficits because of their financial capacity.

Surpluses in industrial countries and deficits in developing countries continue, despite the fact that in developing countries, food production in the 1970s and '80s grew more than twice as fast as in the developed countries. The problem, of course, is—and again, it is central to the theme of this subcommittee—is population growth in the developing world, so that even those countries which did experience growth in their own food production had that growth largely and in some cases fully offset by population growth. So you cannot examine the food issue in any other way except in its relationship to population growth and to the growing nutritional and food needs in existing populations.

Also this situation is likely to be exacerbated in the future as new genetic technologies promise major additional increases in production. But again, this is likely to be concentrated, if we continue on our present pathways, in the same developed countries that now have food surpluses and which are the principal sources of these technologies and have the capacities to apply them.

These new technologies—I was interested, (and I think Lester Brown sounded a very proper caution when he said that we cannot expect major explosions in food production of the kind that we have witnessed in the past,) and my own understanding of the potential of some of these technologies, which is far from complete and certainly not scientific, nevertheless convinces me that they do give us a significant capacity to increase food production by application of capital, energy and research and technology.

Now it is true, however, that overall, probably there is a loss of momentum in the growth of food production that we have experienced in recent times, but I don't think that that potential has been exhausted. In short, we have now the prospect for continued surpluses in the medium term and growing imbalances at the same time. There are going to be surpluses in various parts of the world. There are likely to be growing imbalances and growing uncertainty, because although in the long term the ultimate constraints that Lester Brown again pointed out, the fact that there is a diminishment in the amount of arable land in the world, and there are more and more people, and not only more and more people but more and more people who want to upgrade their diets, but nevertheless, we are going to face at some stage that point at which food production in the aggregate on a global basis will again become an issue.

I don't believe we are quite there yet, but we may think we are there in the next two or three years, that we are still very vulnerable, that world grain stocks are at a very low level now, dangerously low level, and we could see short-term crises too that might make us believe we are back in a fundamental stage of world shortage. I don't think that those crises will, in fact, be a sign that we have moved back into a period of chronic shortages. I think we are likely to be in an overall period of surplus and imbalance for sometime. But in the longer term, there is a prospect of flattening out an eventual decline of the production gains we have seen in recent years.

I believe it is quite right that we are going to face—we are, in fact, now in the midst of increased instability, vulnerability and uncertainty. We simply can't rely on predictions. We have got to be prepared for many crises, whatever may be the long term scenario.

Now what solutions are available then? In my view, only a massive program designed to increase food production in development countries so as to provide them with basic food security. You have heard a good deal about that this morning. To prevent famines. Famines are preventable. Droughts are not, but famines are. And the debilitating effects of malnutrition which are often even worse than famines. Famines catch our attention. The continuing debilitating and destructive effects of malnutrition, particularly on children, seem to elude our attention. And also, such a program should provide a new impetus to economic growth overall in the developing countries. The experience of Kenya, of Thailand, of Malaysia and Taiwan demonstrates that agricultural growth provides a sound basis for overall economic growth. Indeed, it is hard to envisage major and sustained economic growth in most developing countries without a revolution at the level of the rural economy and agriculture.

Finally, such a massive program must be designed to achieve and ensure sustainability. There is no question that much food production in our countries and in the developing world has been based on practices which are simply not sustainable, ecologically, and in some cases, economically. When you look at the levels of energy and technical, chemical inputs required for agriculture, this is not the way in which the developing country can go for economic as well as for ecological reasons. I am not suggesting that they cannot go that way at all. But there are real limitations to the degree to which they should be moving in that direction.

Then, how to do it? Food aid? A problem? Yes. But necessary. Food aid, in my view, is an absolutely indispensable ingredient of our food policies for the foreseeable future. I don't think there is any doubt about it. Many of the bad things that are said about food aid are true. Food aid can be destructive and debilitating. I sat in Sudan with the Prime Minister just a year after the great famine in Darfur, and he had waiting out in his office a delegation of farmers, who last year were absolutely destitute and hungry, this year were complaining that the price levels for their food were such that it didn't pay them to plant it.

So of course, food aid and the mismanagement of surpluses can have a very debilitating effect on production, but what we need is long-term food aid, sustainable food aid. In my view, the time has come to create a new instrument. I call it a world food bank—it could be created as an affiliate of the World Bank—to use food surpluses as a basic resource to support long-term agricultural development in developing countries with particular emphasis on food-deficit and famine-prone countries. Turn this overhang in the market, this asset that is really a liability to the taxpayers of the surplus nations, turn it into long-term capital for development. And as I say, it is not just to relieve emergencies. That is necessary still, but it is to tackle the fundamental problem of revitalizing the rural economy and increasing the food production capacities of these countries.

The bank, I would propose, would be funded by contributions of food from surplus countries and of cash for transport, storage, et cetera from other industrial countries. It would provide assured supplies of food over long term—over long term, ten-year periods. Ten or even more, rolling ten-year periods—as part of a long-term plan to increase food production and improve the rural economy of developing countries.

Now they would have to do their part. They would have to commit to long-term policies of structural change, institutional development, rural infrastructure programs, and to provide the kind of policy environment in which food production—the incentives for food production, can flourish.

Mr. SCHEUER. Would it also include, if not a requirement, then at least a good degree of jawboning on the subject of family planning, which, as you indicated in the beginning, without which none of these developing countries are likely to achieve equilibrium between food and the people?

Mr. STRONG. No, I think it needs to be part of a whole—

Mr. SCHEUER. No, you didn't answer my question for the record. Would it?

Mr. STRONG. Yes, but I think the manner in which that is done has got to be—has got to be—it cannot be a dictate. It has got to be a response to a plan which the developing countries themselves work out and present and negotiate with, and I am coming to this in just a second, as part of the negotiating process I am suggesting that would take place in the World Bank system of consultative groups and consortia which are designed for this purpose.

So this wouldn't be just an isolated little piece on its own. It would be a rural development, agricultural development program within a larger economic development package which would have to include the relationship between food and population, I agree. It would include such things as food for work programs, work on infrastructure projects, work on tree planting, developing of water reservoirs, developing of groundwater resources, et cetera. Food is a very good source of basic capital for such programs.

Mr. SCHEUER. Did you hear one of the witnesses, I think it was the professor from Swarthmore, state that under our PL 480 law, food could not be provided in a program like this if it was going to work?

Mr. STRONG. I am well aware of it. Yes. It is one of the things—you know, you can be very proud of your 480 program, but it really isn't doing the job. I mean, it really needs a major overhaul. Frankly, to give people an inducement to starve—

Mr. SCHEUER. Yes.

Mr. STRONG.—to go on the dole before they can receive any help and to deny them the possibility of developing the capacity to feed themselves over time.

Mr. SCHEUER. It is totally counterproductive.

Mr. STRONG. In fact, Congressman Scheuer, the World Food bank thought or idea is really one of getting a lot of existing practices and putting them into a long context in which what is being done on a short-term ad hoc basis will be done to meet crises and emergencies will, in fact, be done, but on the basis of longer-term development designed to tackle the fundamental roots of the issue and to improve the basic food production capacities of these countries. And it means even subsidies, and there is a very good strong sound economic case for economic subsidies for disadvantaged groups like children.

Research. Here again, most of the research that is producing the new genetic technologies is taking place in the industrialized world. This kind of research is expensive but not beyond the resources of the developing world. I believe that much of that research should take place in the developing world. We should be willing to help develop research which permits them to turn some of their natural comparative advantage, (because they still do have to have that in both labor and in soils, and you know, in many other ways they do have some natural advantages), and to combine those with some of the latest technologies. I think, denied access to their own research and their own ability to develop and improve their crops, that they are going to slide further and further behind us.

Mr. SCHEUER. I don't think you mean denying them access to their own research. What I think you mean is the importance of enabling them to develop their own research infrastructure.

Mr. STRONG. Well, that is really what I meant, yes.

Mr. SCHEUER. Yes. And that they design and they carry out on a hands-on basis in their own countries with local labor.

Mr. STRONG. That's right.

Mr. SCHEUER. With some input, perhaps, and some counseling from experts abroad.

Mr. STRONG. That's right. No—and funding. Funding and technical and scientific experts. No. That's correct. That's what I really meant by "access," but I didn't explain it well.

Mr. SCHEUER. I didn't want the record to be misread.

Mr. STRONG. No, no. You're quite right.

Now, of course, you are talking also about our extension services, about credit marketing, all these things. We have a lot of experience to draw upon. The developing countries themselves have a good deal of experience to draw upon. None of these things that I am talking about are in themselves new. What is needed is a new emphasis on focusing them on long-term development and not crisis-to-crisis—you know, crisis response programs.

Mr. SCHEUER. Crisis management.

Mr. STRONG. That's right. The donor committee would provide long-term assistance, as part of a package of overall agriculture development, of which the food bank contributions would be only one component. Now additional support would come from the World Bank and other multilateral and bilateral donors, coordinated by the World Bank, as I mentioned a moment ago, through its system of consortia and consultative groups.

Now this approach would actually utilize and call upon and not duplicate or overlap with the extensive experience that is available already through such important bodies as the world food program and other bilateral development assistance programs.

In other words, we're not reinventing the wheel. What we really need is a new focal point, a new center of leadership, a new center of initiative which will draw upon, utilize and reinforce, and act as a means of coordinating the existing programs which are all too short term, ad hoc and often disconnected. It would also cooperate closely with the cereal import facility of the IMF. The IMF created a cereal import facility a few years ago and has actually made very little use of it, but it does stand there as an important potential addition to the set of tools we have to deal with this. It is not good enough in itself, because it addresses a narrow spectrum of issues, but it is a useful addition to this kind of approach.

I should just add that the World Food Program, in my view, (I have worked very closely with them), the United Nations World Food Program, is a particular reservoir of experience and expertise in procurement, in transport, in distribution, in food, in the management of food-for-work programs. This World Food Bank, as I conceive it would be closely related to the World Food Program and, indeed, the World Food Program might even become the main building block for the creation of such a World Food Bank.

Then through it all we need this new emphasis on sustainability and the environmental factors which are, as has already been pointed out here, one of the principal constraints now on sustainable food production.

I should also mention that—I haven't got time to go into detail, but that the bank, there would a rotational factor. It wouldn't just be a solely give-away program. Loans would be tailored to the capacity of countries to repay over time out of the utilization of the loans. Food would be the major element, but there could be provision for ultimate repayment in terms of food or other commodities. So that the bank, some of its successful customers, could continue through repayment in kind to nourish and replenish the bank coffers.

Finally, just a few of the advantages I see in a proposal of this kind.

One, it would provide a new center of initiative and focal point for a major advance towards global food security and the establishment of a viable balance between food availabilities and needs on the one hand and population levels on the other hand.

Secondly, it would make full use of all existing capacities and experience and give them a new dimension of support and coherence.

Thirdly, it would move us from a series of ad hoc short- term, crisis to crisis responses to a sustained long-term attack on the fundamental problem which is the capacity to produce food in the countries that need it.

Fourthly, it directly relates agricultural development to overall economic development objectives and constitutes a major attack on poverty, which is one of the principal problems that we have to face in this next century, and surely, poverty threatens the security of all of us. Poverty is the breeding ground of terrorism and disruption, of social instability and conflict.

We have had some very, very striking examples of how—and I referred to a few of them a minute ago, of how agricultural development can be and in many other countries is the only basis for sustained economic and social growth. The Food Bank would turn food surpluses into a resource, a basic source of capital for increasing long-term food production capabilities, rather than just a drain on the economies of the surplus countries. It is the developing countries, after all, who must move to become the world's largest food producers. Four out of five of the people of our planet will, by the end of the century, live in the developing world. The developing world has a lot of capacity to increase its food production. There are constraints. There are problems, but nevertheless, there is a lot of capacity, and we must see that capacity developed.

Finally, it helps to turn chronic food aid recipients into healthy customers and allies. For example, the 24 developing countries with the fastest growth rates in their own basic food staple production increased their net imports of food staples by some 420 percent from the 1961-65 period to the 1979-1985 period. In other words, those who were most successful at growing their own food became our best customers. The average of the others is about 40 percent. It is about 10 times higher. As the capacity of the economy grows through successful food production, nourishing that economy, then their capacity to buy more of the other food that they need grows too.

Mr. SCHEUER. That is an example, as far as we are concerned, of good public policy also being good economics.

Mr. STRONG. That's right, Congressman, but as you well know, one of the concerns that—I live—you know, my U.S. home is in Colorado, where I live on a farm and a ranch. I am very close to the ground in that area, and there is no question that when developing countries are seen as a market for our products, that is very good. People like that. When they are seen as potential competitors, there is a problem. Now these figures illustrate very clearly that although, of course, they can become and will become competitors here and there, on the whole, the increased capacity of the developing countries to produce their own food makes them much better customers for us.

Mr. SCHEUER. Sure.

Mr. STRONG. So our self-interest is ultimately served by increasing their capacity to produce even where occasionally that capacity produced may overlap with—or compete with ours.

Mr. SCHEUER. And the fact is even though they do compete to some extent, they also become a market for our products.

Mr. STRONG. Absolutely.

Mr. SCHEUER. And I would venture to guess that there would be an excess of dollars flowing into our coffers from the food and products they consume over the dollars that they would take away from us in a competitive marketplace, where their food or goods or services would supersede ours.

Mr. STRONG. Right. Well, one very interesting thing on that is that this same group of 24 countries, it is estimated that they will need and will have the capacity to pay for imports of at least 40 million tons per year more than they are now importing within the next 20 years, provided they can continue to increase their own agricultural production which is the base of their economy.

Mr. SCHEUER. Sure.

Mr. STRONG. So here you have—while we are talking about projected food aid increase—or needs for food aid increasing, also the successful developing countries are our biggest growing markets for food that can be sold to them commercially.

Mr. SCHEUER. So food aid that we provide in the short or medium range, in the long range turns out to be not a grant program but an investment program that yields large dividends, large rewards.

Mr. STRONG. Absolutely. It is pump priming, and that is why I see this World Food Bank concept as simply a means of turning the experience we have gained in managing short-term distributions of food into a long-term program that is going to attack the root of the problem and provide an opportunity, at least—it is going to be tough to do, but at least provide the only opportunity I can conceive of at this stage for turning up a potential solution to this crisis, because there is no question that the imbalances we are seeing develop now do have, you know, the ominous ring of crisis to them. You have listened to the panelists, you heard them. I probably missed, you know, some of the earlier ones, but the ones I heard and everything I read and hear from experts these days is pretty gloomy in terms of what is likely to happen if we don't change course. What I am saying is that changing course can make good sense for us. It means changing the rules and regulations now accompanying the use of U.S. food surpluses, particularly, the PL 480, which has been in many ways a useful, but in other ways a destructive instrument.

It does mean the kind of changes, Congressman, that are in the hands of this august body, and I think that what we need to do is energize a new set of initiatives. We don't have to reinvent things. Most of the things have been done. We need to give them new impetus, new focus and a new long- term framework in which they can be directed to the real problems and not just continue putting salve on the wound after the wounds have developed.

So I do appreciate the opportunity of bringing these thoughts before you. I would be very delighted to expand on them, should that be useful.

Mr. SCHEUER. I am delighted that you did join us, and I am delighted in your generosity in staying with us, testifying in a very forthcoming way.

You served on the Bruntland Commission, a group of very distinguished people from all over the world who rendered a very significant report to us.

Can you tell us, what was the fallout, as you perceived it—the Bruntland Commission is now a couple of years old. Do you see it having any fallout? Do you see it having stimulated encouraging trends in the education of women and the ability of women to control their fertility, of young couples to control their fertility, in the willingness of countries to pay some attention to developing sustainable agricultural practices and sustainable manufacturing practices, willingness of countries to protect their base of biodiversity—animals, plants, and the like?

Do you see anything good having come as a result of that commission, in addition to all the critical acclaim that it achieved. My goodness, it was like a bible for us. How do you perceive it having made a difference?

Mr. STRONG. Well, I think, Congressman Scheuer, that it is again pluses and minuses. It didn't perhaps have the immediate dramatic impact that some world reports have, but I believe it has had an increasingly pervasive impact. I know that when I go to schools and colleges and research institutions in this country and around the world, I find that there is a serious interest and there has been a real impact. If it starts at that level, it is going, eventually, to penetrate the political consciousness and the public consciousness more and more. I would say it has made some impact at the political level, but it varies very much from country to country.

In Canada, for example, it has had a high degree of impact. It is surprising, in a sense, and I would say has much greater relevance in the United States. Every province has now formed a sustainable development round table or round table on the economy and the environment.

Mr. SCHEUER. How marvelous.

Mr. STRONG. And well, we will have to wait and see what the results are, but at least, you know, there has been a real impetus.

Mr. SCHEUER. Of course, the whole level of environmental consciousness in Canada is incomparably higher than ours. When I go to Canada, every bellhop, every taxi driver or every bar maid, every anybody is an expert on acid rain, and they berate you in no uncertain terms for what America is doing to them, and they are very knowledgeable, and they are very concerned. Here if you stopped a thousand people at 42nd Street in Times Square, you might get a couple of them, upper income workers in the financial district, and so forth, but I suppose 990 of them would never have heard of acid rain, although I think the perception is gradually spreading. As I mentioned before, Time magazine now has a whole issue on environmental problems around the world.

Mr. STRONG. I was encouraged too at the level of business leaders. I just came from the annual meeting of the World Economic Forum in Davos, Switzerland, in which environment and sustainable balance between economy and ecology was a major, if not the central focus.

Mr. SCHEUER. Were there any Japanese businessmen in attendance?

Mr. STRONG. Yes. Yes. But you know, Japan is interesting, and you will recall, I think, Congressman Scheuer, what they did on pollution.

Mr. SCHEUER. Oh, they've done a great job on pollution in their own country, and they have put in scrubbers and cleaners, and there is virtually no stationary energy sources that pollute, and their cars don't pollute. But that's for Japan. In their investment activities around world they aren't always that enlightened.

Mr. Strong. No. I think that is entirely right.

Mr. Scheuer. I suggested the example of the Japanese company—I forget which it is. I don't know if you saw the New York Times a week ago yesterday. They had a front page story on a Japanese company that was working with the government of Brazil to build a $300 million railroad tie between the Amazon jungle and a west coast port in Brazil from whence all of that mahogany and what not could be shipped right to the furniture factories of Japan.

Now I would like to know how we can convince that Japanese CEO to plan that on an environmentally sustainable basis. I have absolutely no objection to Japanese helping Brazilians exploit their own resources, as long as it is done in an enlightened way that will sustain that resource base.

How do we get the Japanese to develop some kind of a global ethic in their investing around the world, a global environmental ethic that there are kinds of capital investments that are totally destructive and wasteful and result in wanton degradation of the planet, and there are other perfectly reasonable patterns of development of all kinds that are acceptable and that provide for sustainable development?

If there is a bigger buck in the former than there is in the latter, how do we get the Japanese to use in their investments abroad the same kind of enlightened long-term return concepts that they readily employ at home?

Mr. Strong. Well, I don't think there is a magic answer to that but I do think that it is instructive to look at what induced them to do it at home. What induced them to do it at home was that it became a national concern. You may recall that when the Swedes called in the General Assembly of the United Nations in 1969 for a world conference on the environment, the Japanese ambassador got up and said, well, you know, some people might have these problems, but it is not an appropriate subject for a world conference. We don't have such problems. Then came Minemata and an explosion of environmental awareness in Japan, and the Japanese had a kind of national dialogue on the subject. The government leaders consulted with business and community leaders, et cetera, and they decided, yes, they do have a problem, and then instituted a system of incentives and penalties, the highest penalties of any country, and the best incentives.

Mr. Scheuer. Yes, indeed.

Mr. Strong. And so though you can't translate that absolutely to the world level, now that we have this gathering concern at the world level, there will be probably another conference on the environment, Stockholm II in 1992 and the preparations for that should provide an opportunity to focus on some of these issues at the global level and create at the global level a kind of political ethos and dynamic that the Japanese and other businessmen will respond to, not in terms of beating people up but rather say, okay, what is the system of incentives and penalties to which the Japanese and other, you know, multilateral—members of the multilateral business community will respond and have those invoked by international agreement, backed up by congressional legislation.

I think that is the only way. I don't think you could do it by simply appealing to people's good will or converting them to environmental issues. You simply have to provide the system of penalties and incentives to which they will respond, and I think what has happened at the local and national level will have to be moved to the global level. I think more of these issues are going to have to be tackled at the global level, because no one country can go it alone, neither does any individual country, even this one, have the power anymore to go it alone, certainly in environmental matters, but in other matters too. But by the same token, they also cannot afford to, economically, go it alone, if other countries are pursuing policies that add to their short-term economic advantage at the expense of the global environment.

Mr. SCHEUER. Yes. That is sort of an environmental Gresham's law. Bad policies drive out good policies.

Mr. STRONG. Right.

Mr. SCHEUER. You remember your college days. Bad money drives out good money.

Mr. STRONG. Right.

Mr. SCHEUER. So in the competitive sense, it is hard for an enlightened competitor to compete effectively if his other competitors are engaging in perhaps a little bit less expensive, cheaper policies which have really negative implications for the environment and for resources.

Well, let me get to the last question. You note that I have asked many of the witnesses this morning, I think all of the panels, about the whole problem of managing Third World debt, the debt for nature swap.

How do we help them cope with their debt in a way that contributes to their development on a sustainable basis, contributes to their agriculture and ties them into a higher environmental ethic than most of them have been observing up to now?

The reason I did this is because I am the environmental hit man, so to speak, on the American delegation to the Interparliamentary Union. I work with Claude Pepper, and he has more or less saddled me with that responsibility. So I got the IPU to select as the subject for its 100th anniversary, the food-population problem. How do we move toward the goal of achieving equilibrium, globally and by regions, in countries and regions of countries, between food and population. And as a subset of that, they have—at my suggestion, they have set Third World debt management on the agenda, because it is so closely related to sustained agriculture and sustained development, nondestructive development of all kinds.

What can you tell us, not only as the man who headed up the United Nations Environmental Program and is considered one of the global leaders of enlightened environment leadership, but also as a chap who has been a CEO of a major company, who has had vast experience in the private sector and international business and development circles? What can you tell us from the vantage point of the extraordinary experience you have had, not only in environmentalism but also in national and international finance, what can you tell us as to the incentives and the disincentives that we ought to be establishing in this whole area of managing Third World debt, the debt for nature swaps, the business of helping the

Third World but getting them to agree to engage in more sustainable practices than they have in the past, both in development and agriculture?

Mr. STRONG. Well, I think, Congressman Scheuer, that one thing that is not sustainable is the present debt burdens of so many of the developing countries.

Mr. SCHEUER. I take it you are saying this as a businessman, a hard-nosed businessman.

Mr. STRONG. Yes.

Mr. SCHEUER. Who has met a payroll.

Mr. STRONG. Indeed, I think the best way of looking at this issue is to get back to basics. We have a system in this country of how to deal with people and with corporations which are temporarily in trouble, have too much debt, but have an inherent capacity, ultimately, or hopefully, at least, to revive and to become profitable again and be able ultimately to repay their debt. And we call it Chapter 11.

Mr. SCHEUER. Yes.

Mr. STRONG. The basic principle of Chapter 11 is that it enables a borrower, a borrower, a debtor, to rearrange the structure of their debt in such a way that they can continue to operate and hopefully to resume their productive capacity, their profitability and ultimately be able to retain their viability or regain their viability.

Now what do they do when a court reviews a program for Chapter 11? Usually, they look at not only what has to be done to reduce the debt burden. Sometimes they wipe it out altogether. Sometimes they simply rearrange it, or stretch it out, but in all cases, the fundamental principle is that the debt has to be reduced to a level at which the enterprise can continue.

Mr. SCHEUER. Sustainable debt, as well as sustainable agriculture.

Mr. STRONG. That's right. But the other thing is that also the old debt is subordinated to new credit, because developing countries don't just need relief from current payments, they need to be able to attract the additional amount of capital they require to regenerate their economies, just as business in Chapter 11 needs not just to reduce the payments on its debt, but also to attract some new money, and under Chapter 11, that new money gets priority. You go into a Chapter 11, you are able to get new money, because your old money is subordinated to the new.

Now there are some very instructive principles in that. It has worked quite well, a lot of great corporations in this country have been at one stage or other through Chapter 11 procedure, and they have survived and prospered.

Now if you apply that at the international level, you shouldn't just deal with debt per se, you've got to deal with investment too, and I would suggest again, a longer-term approach to the problem. We have gone from—you know, from crisis to crisis, and we have done, with the exception of some relief to the low income countries of Africa that was done on a little longer-term basis, essentially, we have followed again a crisis-to-crisis approach. There is no long-term program now in place to deal with the debt problem. Developing countries have got to get into a crisis before they can get any attention and get any change.

Now what I am saying is that we should create a means, again, (the World Bank and the IMF provide the basic infrastructure and support base for such an initiative), but what about an Independent Debt and Investment Board, to which developing countries could go with their own program for regenerating their economy, saying, here's what we are going to do to regenerate our economy. Here are the measures that we are going to undertake to do that, the policies we are going to change, the kind of domestic fiscal environment we are going to create, and here is what we need in terms of debt reduction, and here is what we need in terms of new investment, because the two have to go together. You can't just, you know, have debt reduction without a capacity to attract new investment. And then bring—you know, work out a package with them, a package which will permit them to reduce their debt burdens. Now that will have to be on a case-by-case basis. It preserves the case-by-case approach which the Western banking community is so adamant in preserving, but it does apply a set of consistent criteria. The criteria would include what actual repayment levels, capital and interest, can this country support and still be able to resume its planned economic growth.

Then what kind of new investment does it need and how does it best attract that? Some by way of foreign aid, you know, contributions, some by way of commercial borrowings, and why not, again, use the Chapter 11 concept and enable new money to be senior to old money? It doesn't wipe out the old money, but it does put it a little bit down the—gives it less seniority.

Mr. SCHEUER. They have to wait a little longer.

Mr. STRONG. Exactly. So that the chances of them being repaid, ultimately, are increased and the illusion is that the loans are still viable loans on their books. Now that is an illusion which those banks are recognizing now by gradually writing down and writing off much of the Third World debt. But it is still an illusion. These countries cannot do it, and if we look at the history of this country, much of this country was built on defaulted debt. You know, the developing countries have been far more faithful to their commitments to their bankers than the entrepreneurs and builders of our country were during an earlier stage. You know, I mean, how many great railways and utilities went through the wringer and squeezed out the foreign bondholders and, you know, debtors before they finally became viable enterprises?

I am amazed that the developing countries have been so patient, so willing to accept it, so coerced by the financial community into not defaulting on their debt. It used to be a great virtue, you know, in the last century in this country, you know, the anti-banker attitudes. We've forgotten our own history. Some of the developing country finance ministers, though, they have studied history in our universities. They do understand that debt repudiation, and anti-bank attitudes were politically popular platforms in our country not all that long ago. In the farm belt today, some of those attitudes have resurfaced.

So I don't think there is any great magic, Congressman Scheuer. I think we should invoke some of the methods and procedures that have worked well here to revive people so companies have a capacity to become productive again. You have to do that by making it possible for them to get the new capital, to attract the new capital they need to regenerate their economies. And that has to be done over time. It cannot be done on a willy-nilly, year-by-year basis. Whenever the bankers feel that there is enough of a crisis, they do something for another year or two and, you know, you can't expect to regenerate the economies on that basis.

I'm sorry. I got into this one a little longer than I intended.

Mr. SCHEUER. Well, I am delighted you did. I have the feeling—and this is off the record.

[Discussion off the record.]

Mr. SCHEUER. I feel embarrassed that you had to wait so long, but on the other hand, I feel very pleased and rewarded by being able to sit here and listen to you expand your ideas in some detail. You have enriched my experience, and you have given us a wonderful record on which to formulate legislation.

As a result of your very, very thoughtful and more lengthy than usual testimony, (normally the time constraints, the five-minute rule and what not, prevent us from having this kind of a discourse), I am very grateful to you that you were able to stay and give us this really fine, rich representation of your views and your experience. I am very, very grateful to you.

So the meeting will be adjourned.

[Whereupon, at 12:53 p.m., the hearing was adjourned.]

[1:00 p.m.]

Mr. SCHEUER. The subcommittee will reconvene briefly.

I am going to ask unanimous consent that this question be placed at the point in the record when we were discussing the problem of our food aid which cannot be used as capital, in effect, and must be used for charity and not for production or development or other purposes.

Mr. Strong, can you give us your views on this anomaly in the American law that seems to go against the grain of our Protestant New England work ethic, the Puritan ethic? It goes against the grain for people who urgently and desperately need the food but who have pride and who want to work. Tell us your views on the matter and especially tell us of your experience of organizing and directing, along with Brad Morse, a former great member of this body, emergency African food relief program.

Mr. STRONG. Well, Congressman Scheuer, I think the best answer is, in fact, the experience that we had on the ground in Africa during the great famine emergency of 1984-1985, and it was a bitter paradox to be there with people who were hungry, yes, but who are willing to work, who wanted from the point of view of their dignity to work and earn their food, and we simply couldn't use U.S. food aid for that purpose. We had to wait till they were starving. You could only give it away. You cannot use it for programs of constructive work, which clearly—you know, is so puzzling to foreigners who understand that that is not the way America thinks. That's not the basis on which America operates, and yet to send generously, as America does, food aid abroad and then not allow it to be used to help those who want to work, who want to rebuild their lives, to do so, to have it used only once they've got down to the point where they are starving, it just doesn't make sense, and I saw many examples of it where we had to use food aid from other countries.

Mr. **Scheuer**. Which countries?

Mr. **Strong**. From Canada, from Australia, even from India. There was some food from India in some parts of Africa. We could use that for food for work programs, but we could not use U.S. food aid for that purpose.

Mr. **Scheuer**. That is an extraordinary anomaly that ought to be changed, that absurd policy should be reversed. Anything else?

Mr. **Strong**. No. I thank you.

Mr. **Scheuer**. Thank you very much. We will now finally suspend this hearing.

[Whereupon, at 1:05 p.m., the hearing was adjourned.]

APPENDIX

OVERVIEW OF THE GLOBAL FOOD AND POPULATION SITUATION

THURSDAY, MARCH 2, 1989

Committee on Science, Space, and Technology,
Subcommittee on Natural Resources, Agriculture
Research and Environment,
Washington, D.C.

The subcommittee met at 1:42 p.m. in Room 2247, Rayburn House Office Building; Honorable James H. Scheuer, chairman, presiding.

Present: Representatives Scheuer, Schneider, and Smith.

Also present: Eileen Lee, Science Consultant; Wesley Warren, Technical Consultant; and Michael Rodemeyer, Staff Director and Counsel.

Mr. Scheuer. All right. Now we're in an informal living room setting. We are keeping a stenographic record so that we can distribute your remarks. Your prepared testimony, of course, will be printed in full in the record. We will draft a report that will highlight the main points that you're making, the conclusions that we come to, and we hope that it will be of very great use to parliamentarians all over the world to whom we will be sending it, especially those who will be delegates to the Interparliamentary Union Conference next September in London when they are celebrating their centenary meetings, centenary celebration, by considering exactly the subjects that we are considering today: the global imbalance between food and people; how we achieve equilibrium; and, as a collateral but very important subset of that, how we manage the problem of Third World debt.

Okay. This is now, as I say, an informal briefing session. Why don't we start to the left and move to the right?

Sat Pau Mittal, one of the founders of the Global Committee of Parliamentarians 10 years ago, and even in the two or three years that preceded that, traveling around the world with myself, Akio and others of you, Bruce Halliday of course was involved at that point in time. Sat Pau has been a Member of the Indian Parliament for 25 years. He is Chairman of the Indian Association of Parliamentarians on Population and Development, has served with distinction as Secretary-General of the Asian Forum on Population and Development. He was awarded the 1987 United Nation's Peace

Medal for his work in motivating parliamentarians in the field of population and development.

We are proud and honored that you traversed the oceans and the airways to come to us, Sat Pau Mittal. Why don't you chat with us informally in this living room environment for the next five to 10 minutes, and when we've heard from the other witnesses we may very well have some questions for you. As a matter of fact, we expect to have several other members joining us, but while I'm here without too many other members making claims on time, I may even interrupt and ask you a question in this informal living room environment as we go on.

So please deliver us of your wisdom and your counsel, taking note that your prepared remarks will be printed in full in the record, as the prepared remarks of all of the other gentleman who have delivered excellent prepared testimony will be printed in the record.

STATEMENT OF SAT PAU MITTAL, PARLIAMENTARIAN, INDIA

Mr. Mittal. Thank you, Congressman Scheuer for giving me the floor. I am honored, and I will be speaking for all of us, if I say we are all honored by the invitation that you extended to us to come for this hearing.

This is very unusual, even for all of us, to come to interact and talk informally as you rightly said, with our counterparts in this part of the world, the United States of America, on whom we all look with pride as a country, a great country, with great traditions, a great country struggling and striving for perpetuating human values of the highest order on this planet. We are deeply honored.

We are especially honored because we have been working with you and under your guidance in the Global Committee and other fora on causes which are very, very dear to all of us because they ultimately tend to promote human survival on this planet.

I must admit for myself that I have been looking forward ever since I received your invitation, with great hope and expectation for this event because this will give me and my colleagues a rare opportunity of exposing ourselves to interaction with our counterparts in this part of the world.

Population and development is what we have been involved with for over a decade now, not only locally and nationally but, as you have said, at the regional level and at the global level. Population of any country, of any continent, is an asset for that country so long as it does not overtake the human and natural resources of that country.

In my country we have always equated population to Mother Ganges. I should hope you can see what I mean. We Indians have treated the River Ganges, Mother Ganges, as providing us all the sustenance that it does. The vast masses of people in India, we call it Mother Ganges, have always equated population with Mother Ganges. But when Mother Ganges a few years ago in rage and in spite devastated most parts of Patna, we refused to call it Mother Ganges; it became a devil Ganges.

Similarly, population is an asset for the country. But when it breaks the barrier and, like Mother Ganges it flows beyond it, it tends to devastation, destruction—in this case destruction of human and natural resources—it doesn't remain an asset; it becomes a liability.

So population has to be evaluated in the context of development. That is how we parliamentarians in that part of the world have been working, with a view to bringing the kind of an equilibrium, a balance between human and physical resources on the one hand and population on the other.

Unfortunately, I come from a country, India, with great values, great traditions, Asian traditions we are rightly proud of, but a country which accounts for a little over 16 percent of the total world population as against 2.6 percent of the total land area of the world. You can understand the anomaly already existing between the land area available and the population, the percentage of population, the proportion of population.

The nexus between population and development is something which has to be kept in view in order to bring about balance. That is what the economists and planners have to keep in view while planning the affairs of their country.

Asia, as we all know today, accounts for 60 percent of the total global population. Two countries, India and China, put together account for 40 percent. You understand the problems in Asia. The problem of population explosion is in the developing world. By the end of the first quarter of the next century, 93 percent—according to the latest projections—93 percent of the population taking place will be in the developing world, and out of that 93 percent, 90 percent will be the labor force.

I am trying to give you a picture, a realistic picture, so as to convey to you the gravity and the enormity of the problem which the developing world is facing and has to face in the near future in terms of the resources which are depleting day by day.

Now, you have to keep in view these staggering figures of population growth which is unabated, continuing with approximately the same speed, as you can see from my paper. In the years 1970-71 to 1980-81, the growth rate annually was 2.27. And in the next decade it was 2.2. Thank God, thanks to the planners, the administrators, who took the agricultural management techniques and new varieties of seed, new fertilizers, the latest techniques in methodology, that we were able to take care of our agriculture production as well.

Agriculture production in the corresponding years, 1970- 1980, that figure is approximately 3 percent compared to 2.06, thanks to the planners.

India, which as was criticized by the media and the opposition very frequently, used to go to the world with a begging bowl, but within a short span of about six to seven years, we were able to organize our agriculture along scientific lines and the result was that within this short span of time, we almost acquired self-sufficiency in food grains—not in all kinds of food grains, not in all seeds, but crude food grains we were able to do that.

But with the present rate of a little over 2.0 percent in growth rate in population, how long and how far can we go? According to the projections that the Planning Commission of India has made and the projections by the United Nations as well, by the year 2000 India's population is going to be, say, 1 billion.

Mr. **Scheuer**. Isn't it contemplated that not long after the turn of the century, maybe 2010 or 2015, India's population will surpass China's population?

Mr. **Mittal**. Not exactly, but it will be close to China's.

Mr. **Scheuer**. I understand from World Bank figures, that China is scheduled to stabilize their population at about 1,650,000,000 people sometime around 2015 or 2020, and that India has planned to stabilize her population at around 1,750,000,000 or 1.8 billion.

Since this is informal, I will recognize the fact that Fred Sai is sitting there nodding his head. Fred, tell us about when, if at all, when will those two lines cross?

Dr. **Sai**. It is getting increasingly difficult, sir, because of two things that are happening at the same time. The Chinese population program, their family planning program, has been suffering some setbacks recently whilst India is putting a greater emphasis on their population programs.

So you are right. The present thinking is that these two lines will cross between 2015 and 2020. But whether they will actually cross then, I don't think we can say for another three or four years.

Mr. **Scheuer**. Very good.

So hopefully the effectiveness of India's population and family planning programs will increase to the point where perhaps they never will cross.

Mr. **Mittal**. If the family planning program works well, and that "if" is a very big "if," and if we achieve our target of the net rate of unity by the year 2000, I have no reason to be panicky or alarmed about future projections. And I don't think in that case the estimate that we'll be crossing the line with China in the year 2020 or 2025 seems to be accurate.

But, as I said, that "if" is very important. China's program has not been working well, as we know already. From the latest projections that we had last month in Manila, it is suffering from a number of setbacks, but that is of no satisfaction to us, because we are working in a different set of political circumstances, different from them.

So ours is a very difficult kind of a task inasmuch as we have to carry the people with us along the total program, and we have to make them accept the small family way of life. Unless we carry the people with us, we cannot make the program a success.

We all know that the element of compulsion may be minimal in China, but it is there. And we all know that their system of public adminstration is different from that of India's which is democratic. So in a democracy, you have the opposition always at your throat, and all kinds of pulls and pressures are there.

So it is difficult to work in a democracy to achieve results as fast as you may perceive it from a system of government that is different from a democratic form of government.

Mr. **Scheuer**. In other words, you're saying that the kind of draconian policies that governments like China's can devise, that are pretty relevant to—

Mr. **Mittal**. I wouldn't like to call it draconian. I wouldn't like to call it draconian, but I will say there is an element of compulsion.

When I say that, now look, one party is working—the Communist party of China, whatever they decide is law.

In my country or in your country, no single party, Republican, Democrat, or for that matter Congress, Socialist party, Communist party, in my country doesn't run. It is the government, which is the Parliament. So in that case, you have to carry the opposition with you.

I was coming to that, Congressman. I had a very tough task after the program of family planning was derailed in 1977 in my country. When this family planning alone was blasted and politicized to an extent as to be used in the election plank in 1977, I had a very, very tough time to organize parliamentarians on a national basis cutting across party affiliations. You know that.

It was a very, very tough task to sell this program as a national program cutting across party barriers. It was very, very difficult to convince political leaders of all national and regional political parties that, look here, we may differ on programs and policies, but here is a program which is a national program because it relates to the well-being of all Indians, well-being of people as a whole, for which we all profess.

So in a country, democratic as it is and, like India, a very vast country, it is very, very essential to carry the people with you in a program like population planning or family planning where it relates to a very sensitive area of human behavior. After all, sex is something which is very, very personal. The people don't like the state intervening in their so personal behavior.

So you have to approach it with a great deal of certainty, with a great deal of persuasion and education, and you have to carry the people with you right up to the grass roots level if you want the implementation of the policies and programs at the national level.

That is what I want to impress upon you. In my country, in a given political situation, it's absolutely different from what it is in China. So I wouldn't like to call it draconian. I don't want to be accused of calling their program draconian, but you know what I mean.

Mr. SCHEUER. Yes. Look, I think they would admit that their policies are draconian and I think they would say that our circumstances and our national prospects, absent these draconian policies, would be so devastating to the health and the development of the Chinese people that we need draconian policies to assure a future of decency and happiness and fulfillment and for the proper productivity of our economy and our society.

I think they would say that their circumstances are more threatening than their policies are draconian, designed to meet those circumstances. After all, I am told—now we may have to lean on Fred Sai here again—my understanding is that if China had not started these, let's call them very "rigorous" programs in the last couple of decades, that by the year 2010 or 2015 or 2020, let us say, China would have reached approximately the current population of the entire globe, about 5 or 5-1/2 billion, had they not started those very strong and forceful policies a decade or two ago.

Dr. Sai, am I way off the beam on that?

Dr. SAI. I think the size is just a little large, sir, but it could have become double now in size.

Mr. **Scheuer**. Double by now, so you'd be up to a little over 2 billion, and I suppose it's not unreasonable to think that in another 25 years, by 2015 or 2020, it could have doubled again. So you would be up over 4 billion.

Mr. **Mittal**. Congressman, my understanding is that if they had started this program in the '50s and '60s when the marriage boom and the baby boom had started in China, things would have been different. But that's for them to decide.

But I would in the meantime like you to join me in leaving this to them, whether to call it draconian or not.

Mr. **Scheuer**. I can assure you that we consider that their business. I led this subcommittee on a study mission to China about a year ago, and we satisfied ourselves that their policies are appropriate to their problems. We satisfied ourselves that there had been some abuses in terms of compulsory abortion. They were aware of them. They regretted them. They explained to us how they were reprimanding and punishing the local officials who had acted with an excess of zeal.

And we wrote a report saying that every country has the right to design policies that are appropriate to its problems, and we think that in general China has done that. If China had been left to its own ways and they had reached a population of 4 or 5 billion, more or less equal to the entire remaining population of the globe, China would be a different kind of a neighbor than it is now and that presumably it will be.

China would at that point in time be an aggressive, imperialistic, expansionist state with an omnivorous maw for land. They would seize every square inch of land that wasn't nailed down and that wasn't being adequately protected by significant military power. They would be an incredibly destabilizing and disruptive force not only in Asia but in the whole world.

And I think we should thank our lucky stars that they had the character and integrity to create programs that matched their conditions and that they were able to enforce comparatively severe, comparatively unpopular programs that in the Western democratic world just might have been non- starters from word one.

I doubt whether our country could do something of that kind. If you look at the aberrational quality of the American family planning philosophical design both in our own country and in our foreign policy, you wonder how a great country of ours could have such retrograde policies that were so irrelevant to the realities that we face.

Well, anyway, we're not discussing the United States now, but I hope that in another year or two or three, when all of you come back to counsel with us and try and achieve some kind of global consensus on the kind of policies that are relevant, that our country will have resumed the position that it had for so many decades, certainly for the decade following World War II when we were the leader, the acknowledged leader in the world in bringing enlightened, thoughtful, relevant family planning programs to the developing world.

Now we are not part of the solution; we're part of the problem. And to me it's deeply embarrassing. I hope that will change. I can tell you that between 1967 and 1970 when I was working on the first major consolidation and recasting of our family planning programs which ultimately ended up in the creation of Title X, there were two congressmen that I could always count on for support. One was Robert Taft, Jr., I think the nephew of the senator, and the other was George Bush of Texas. George Bush was one of the enlightened members of the Republican party at that time, a founding member as I recall it of the Breakfast Club, which was the thoughtful and moderate Republicans who were trying to preserve the centrist base of the Republican party. And I hope that we'll be seeing that kind of leadership from George Bush in the not-too-distant future.

Please continue.

Mr. MITTAL. It is very heartening to know about George Bush being involved in this when he was the Republican congressman. I hope with him as the President of the great United States of America, the policies will be more realistic. We all hope that, as usual, the U.S. will show the way to the free world.

Anyway, Congressman, what is worrying me is not the present state, where in any case we have been able to create some semblance of balance between resources and population. What is worrying me is the future.

At the present rate, are we not mining the resources of the earth and the sea? We are putting fertilizer into the earth in order to produce more, not realizing that there is a limit to earth's fertility also.

There will be a time when the fertility of the earth will come to a standstill, if not end. There will be a time when the resources of the sea for seafood will be limited no further, no further from land, no further from sea. What is going to happen at that point in time?

The present generation is mining the resources of the earth and the sea. Congressman, I am putting the question: Are we not borrowing recklessly from the future? Is the present not borrowing recklessly from the future? Will the present not be in a position like some of the developing countries which are groaning under the weight of indebtedness today, which is the main cause of economic crisis all the world over?

Similarly, in relation to population and food also, Fred Sai is here—such an outstanding personality, outstanding resource person, I would say that. I want to put a question to you, Dr. Fred Sai. Is the present not borrowing recklessly from the future to a dimension where the present will never be able even to pay the interest on that?

My worry is that we in due course of time might render the earth and the sea to a very large degree less fertile, if not infertile. What is going to happen at that point of time to the humanity, large mass of humanity that is increasing every day, every minute, every second?

We know, I don't have to quote the figures, how many people are born every second or every minute. I have all those staggering figures; I don't want to quote them. But what is going to happen to the humanity at large for whose well-being and welfare we public men always profess to be working?

That is my worry. My worry is not only for my country, all the Asian part, but the entire humanity. As a parliamentarian, as a public worker, I am concerned with developing the welfare of the human race on this planet. That is why I have always talked in terms of population in the context of overall development, in the context of human and physical resources.

Mr. SCHEUER. When you talk about borrowing from the future, you are echoing the words, or perhaps Bruce Halliday will be echoing your words on page 8 of his testimony.

Mr. MITTAL. Oh, I haven't had the pleasure of going through his paper.

Mr. SCHEUER. And he talks about the continuing draw- down of the earth's basic environmental capital.

Mr. MITTAL. That only shows the similarity and commonality of views or the same brain wave, because we are working hand in hand, so we can read each other's mind. He may have spoken in that fashion also.

Congressman, my anxiety is that the depleting resources of energy, or drinking water, or coal, or gas, or oil—what to talk of these things? What about the topsoil, that 2-1/2 inches or 3 inches of topsoil which gives this Mother Earth fertility for growth? Because of the deforestation, the rate at which it is taking place, which is causing devastation in terms of floods, sometimes in terms of severe droughts and severe floods, which takes away the upper layer of the earth which is fertile, rendering the earth infertile. With the present rate of deforestation taking place, resulting in desertification ultimately, I can see when I fly from New Delhi to Katmandu and I see it being denuded because we are cutting recklessly the forest, the woods, for all kinds of use, not realizing that we are only playing with our own immediate future.

So I shudder to think with the depleting resources, natural and human, where are we heading to? Where are we leading to? Will posterity ever pardon us for not taking care of these essential matters, important matters, at this point of time when we could do something to contain it, to perpetuate it, to promote its growth? Then we'll be washed away from history and will not be the actors on the scene to make any amends any further.

That is my concern, Congressman. With that concern, I have given you these comments which flow from my concern for the general good of the people for whose well-being and welfare people profess to be working for.

[The prepared statement of Sat Pau Mittal follows.]

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Note II

THE FOOD ECONOMY

India

By Th. Sant Paul Dhillon 7-4

It can be seen from the following tables the population recorded an annual rate of growth of 2.27 per cent per annum in the decade 1970 to 1980, whereas production of foodgrains just increased by 1.8 per cent during the decade. During the next five years the population grew at the rate of 2.2 per cent but at the foodfront there was a considerable improvement, the growth was over 3 per cent. Of late there have been considerable improvement in the Per Capita Net Production of Foodgrains.

Table I

Year	Population (as on Ist October) (in millions)	Growth rate over the previously mentioned years (% P.A)
1970	541	
1980	679	2.27
1985	758	2.20
1994	912.7	2.06
1999	995.6	1.74

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Table II

Production of Foodgrains

Year	Production of foodgrains (million tonnes)	Growth rate over the previously mentioned year (%P.A.)	Per Capita Net Production (Kgs.)	Growth Rate over the previously mentioned year (% P.A.)
1970-71	108.42		175	
1980-81	129.59	1.8	167	(-)0.47
1985-86	150.47	3.03	174.7	0.83
1994-95	206	3.55	197.5	1.44
1999-2000	240	3.10	211	1.38

It is expected that the Annual Growth Rate of population during the period 1985 to 1994 would be reduced from 2.2 per cent per annum to just over 2 per cent per annum whereas on food front during this decade there will be a further improvement in the growth of foodgrains production i.e. it would be around 3.6 per cent.

The population in the year 2000 A.D. may be around 996 millions whereas production of foodgrains is projected to be 240 million tonnes. The projections made for the various years for the population takes into account the effects of well organised family planning programmes and would be put into operation during the perspective plan period. The perspective

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for the end of 2000 A.D. the growth in population may be further reduced to about 1.7 per cent whereas the growth in subsequent period after 1995 is anticipated over 3 per cent. This implies that per Capita Net Production would become around 211 kgs.

Whereas India's agriculture has taken massive strides during the three and a half decades of planning, the perspective plan for agricultural development aims at maintaining self sufficiency in foodgrains and attaining self sufficiency in respect of pulses, oil seeds etc. Its other objectives are to maximise employment opportunities and to promote conservation and environmental protection measures so as to arrest the degradation of natural endowments of soil, water and other resources. The above mentioned figures are in line with meeting the requirements of self-sufficiency. The achievement of this target of 240 million tonnes by the end of the century will be made possible by increased use of fertilisers and irrigated areas and by improvement in technology coupled with extension of research work to the fields. For achieving the target of foodgrains and other crops the requirement of fertilisers by the end of century has been estimated around 20 million tonnes and that of irrigation around 100 million hectares while the

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required production of cereals appeared to be attainable more interactable problems are likely to be encountered in the case of pulses and oilseeds keeping in view the importance of attaining self-sufficiency in later two crops. It would be necessary to undertake special measures to increase their output. New high yielding varieties which are required to be sufficiently drought resistent will need to be evolved and brought into production. Besides the extension and intensification of research the perspective plan envisages the introduction of modern management techniques in relation to irrigation and agricultural extension services. The form and revitalisation of the cooperative movement would form an important plank in the programme of agricultural development. The improvement of productivity of the rainfed areas (which may constitute over 70 per cent of crop lands by the end of this decade) has a very close bearing on the well being of a large mass of the population. An important strategy for agriculture in the perspective plan period would be to intensify research on dry land farming, accelerate the transfer of new technologies from the labortory to the farm and to channelise more credit into, and develop marketing facilities in, dry farming areas so as to assist in the speedy application of new technologies.

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Management of the Indian food economy also plays a very important role in building up of a proper food security system. The three important component of the management of food economy are : (a) Procurement and support prices, (b) building up buffer stocks, and (c) distribution of foodgrains on subsidised prices to the poor sections of the population. This system helps in stabilising food prices, giving incentive to the producers and meeting the minimum food requirements of the poorer sections of the population. It is mainly due to evolution of such a system that famines could be averted in a recent severe drought year and run-away inflation could be prevented.

Mr. SCHEUER. Thank you very much, Sat Pau Mittal.

We have been joined by the Ranking Minority Member, the Ranking Republican Member of the subcommittee, Congresswoman Claudine Schneider of Rhode Island. She has been a great leader in problems of the environment, population, women's issues, and we are delighted to have her here.

Sat Pau, you mentioned that you couldn't compare India with China, a whole different set of political and social circumstances in which you would have to make public policy in India compared to China, and we understand that. But there seem to be significant differences in the success of India's family planning programs from state to state and region to region.

For example, I understand that the family planning programs in the state of Kerala are significantly more effective and family planning is significantly more accepted than in other parts of India.

Mr. MITTAL. Right.

Mr. SCHEUER. Can you explain that phenomenon to us, and perhaps give us some understanding of the predictable likelihood that other states will learn lessons from the state of Kerala and perhaps some other states that have been successful? Are there lessons to be learned, and how are they to be applied? And what is the role of your new Center on Population and Family Planning in analyzing the situation and disseminating information?

Let me congratulate you on the noble role that you played in organizing that first Asian center for studies and teaching and dissemination of knowledge in the whole field of population and development.

Mr. MITTAL. Thank you, Mr. Chairman.

The recent studies on this very situation have revealed that Kerala is far ahead of some of the states in the north because, primarily because the percentage of female education is much higher in Kerala than in other states. The studies reveal that 60 percent of the females, even in the rural areas, are educated compared to Rajasthan, compared to Uttar Pradesh, compared to Madhya Pradesh, compared to Bihar, where the rate is much lower than the national average.

Mr. SCHEUER. The rate of what?

Mr. MITTAL. Literacy. The female literacy rate in Kerala is much higher, as I said. It's 60 percent even in respect to female literacy in the rural areas compared to less than the national average in Rajasthan, Madhya Pradesh, Bihar, and Uttar Pradesh.

So this means that if you leave the program to women, they do it better than we men. And since the distinguished woman parliamentarian has taken over, I am not saying it to please her, but this is a fact. And my wife is not around that I am trying to please her either, to have a good visit back home. No, that's not my intention.

But if you leave the affairs of the family to women, they manage it better than the men do. And if you leave the size of the family to be determined by women, they shall certainly be content with a small family that is happy, and a contented family, the prosperous family, than do men who have been wrecking the family unity system, even in traditional countries like India, Pakistan, Bangladesh, and others.

So the focus is that population planning has a direct bearing with female literacy.

Mr. SCHEUER. From female literacy?

Mr. MITTAL. Yes.

Mr. SCHEUER. So you adopt the motif, let us say, that literacy is the best contraceptive.

Mr. MITTAL. Literacy is the best one, and also apart from literacy, you have to give women the status in society. We have been talking of giving them equal status. Have we given them equal status? Let us accept it; we have not. I'm not talking of the United States of America where you may have given more status to women than men.

Ms. SCHNEIDER. Oh, don't admit that too quickly.

Mr. SCHEUER. I would like to yield now to our great lady parliamentarian who is such a role model and such a leader in the whole question of women's rights and women's progress and the role of women in development all over the world, Claudine Schneider.

If you have any opening remarks to make, please do, and ask Mr. Sat Pau Mittal any questions you may have.

Ms. SCHNEIDER. Let me say that I appreciate the wisdom of our chairman, because as you can see he is flanked by two women, his consultant and his Ranking Member.

I would like to also point out that perceptions and realities are something that we must be sensitive to, particularly in the perception of the role of women in the United States, and there are so few of us in the U.S. Congress and Parliament, but yet we continue to work toward bringing about greater economic equity. We may be literate, but our advances are also limited economically.

But I would like to ask you the question, and perhaps of the entire panel: Is there a unanimous feeling that Mr. Mittal's remarks are on target? That if, in fact, women are literate, they are more inclined to limit their family size? Are you in unanimous agreement there? Yes, I see heads nodding.

Well, let me ask you: What role can the United States best play in assisting your countries to achieve that end, because we are very sensitive that we not be in a situation whereby we are dictating to other nations what they should do with their lives. So what would you say would be the most diplomatic approach that the United States should take in order to achieve the goal that you mentioned?

Mr. MITTAL. That is a very difficult question. I don't think I can off the cuff make any remark on that.

Mr. KEY. I can.

Mr. MITTAL. You can? Then please feel free to do that.

Mr. KEY. Refund the UNFPA.

Ms. SCHNEIDER. Okay. Are there any other areas of leverage that the United States might have that could achieve that same goal?

Mr. MITTAL. If it is not bringing politics into an academic discussion, the United States can play a very great role in lending efforts to stabilize the political situation in that part of the world, which can go a long way in the ultimate analysis for bringing in more prosperity to that region. Political stability is something which the United States can certainly foster.

Mr. SOTOMARINO. I consider it myself very dangerous to cut the help, the assistance to institutions like IPPF, as was the recent position of the government of the United States.

Mr. SCHEUER. In connection with what leverage can work in the developing world, I was told maybe four or five years ago by Ernest Stern, who was the Executive Developer of the World Bank at that time, that within five years there wouldn't be a single country in sub-Saharan Africa that wouldn't have a major family planning program, a major maternal and child health program as a component of its overall development. And that was coming by a lot of jawboning, as we say, by a little bit of arm twisting, by a little bit of persuasion, to convince them that when they ask for programs of agricultural assistance, industrial development assistance, and education and health assistance, that to make it all real and to create the possibility that they may create an equilibrium between food and people, that they were going to do the best they could, the World Bank personnel, to make sure that maternal and child health programs were included.

Now, I think the five years is just about up. I don't think they have achieved quite that goal, but there has been an enormous increase in the number of countries in sub-Saharan Africa that now have formal family planning and population programs that are approved by the chief of state, funded by legislatures and so forth.

And I wish to say that the global committee has played a very significant role in this. Akio Matsumura organized the first African conference on population development in Zimbabwe in 1986, where I had the honor and privilege to attend.

Minister Kwidini is also providing great leadership. Robert Harrare made a marvelous speech at our conference. His finance minister, Bernard Chidzero, gave an absolutely smashing speech supporting population development and said, in effect, that our economic future is bleak indeed if we don't get a handle on our population growth.

Abu Diaf, the chairman of the African OAU, gave a splendid speech. So the momentum at the leadership level has been gathering and the World Bank and perhaps our population aid program have all added to the momentum and the acceptability.

Mr. MITTAL. Yes. I was responding to your query about the Asian center.

Mr. SCHEUER. What is the center doing and how is it spreading the word?

Mr. MITTAL. I understand. Before I do that, I want to tell Madam Congresswoman that I was not saying, about the role and status of women, just for the fun of it. We are all convinced on that score. That is why we were able to sell this idea to Akio Matsumura and, through him, to the Asian forum that we must help in organizing the Asian women parliamentarians to take the leadership role.

And for that purpose we have decided to organize a conference of Asian women parliamentarians in Delhi this September on population and survival. We are convinced that the survival of humankind on this planet is only possible through the leadership role of women.

That is why we are organizing it, and hopefully the Prime Minister of India will inaugurate this conference, and if protocol doesn't get in the way, we may have Bhutto come and deliver a keynote address.

So you can understand that we are generally convinced that the women must be encouraged to take the leadership role in family planning and family welfare. Only then can this policy improve and be implemented faithfully in totality. That's about it.

Mr. SCHEUER. Fred, would you like to come up to the table? We'll save you for your wind-up position. You're our home run hitter, but if you'd like to come to the table so that you can contribute from time to time, just pull up a chair and sit at the end and Robert Key will pass you the mike. No, sit next to Sat Pau Mittal.

Look, we are going to call upon you when all of them are finished and all of our questions and answers are finished, to make the final round-up. You're the home run hitter, so don't spill it all in the course of the discussion here. But any comment you wish to make.

Dr. SAI. I just wanted to inform the congresswoman that her question about literacy of women and so on is a question which has been answered very clearly in research terms all around the world. But it is not an alternative. But the role and status of women, the education level of women is so very directly linked to the total survival of the family, the health care and so on of the family, the use of contraception, the distribution of resources, that one good thing that the U.S. can do would be to help to support the growing institutions that are dealing with women in development generally.

Mr. SCHEUER. In other words, you're saying that because of our hangups of various kinds, the problem of giving family planning aid is too dicey for us (and we got hung up in these absurd Mexico City policies that you wrestled with so nobly in 1984 when you were chairman of that conference,) if we just continue in this hangup and we immobilize ourselves in giving direct family planning and other kinds of population aid, we can sort of compensate for that by being more active and more supportive in giving education aid and assisting in improving the role of women throughout, about which there is very little controversy in the United States.

Okay. Now, look, we've taken much too long with you, Sat Pau Mittal, before hearing the other witnesses, and I take the blame myself because what you said was so intriguing. But now we're going to move on to the other witnesses and then when the time comes for questioning back and forth—no, no, no, don't move; sit right down. But we're going to move to the other witnesses.

We have some questions, I have some questions I haven't had a chance to ask you. But I think the thing to do is move along and then I have some more questions for you at the end of the day.

Do you have any opening remarks that you would like to make?

Ms. SCHNEIDER. No. I think that perhaps I'd like to hear from the witnesses first.

Mr. SCHEUER. Very good.

Next we will hear from Bruce Halliday. Bruce Halliday is a Member of Parliament from Canada and he's Chairman of the National Health and Welfare Committee in Canada. I have known Bruce Halliday, as I've known Sat Pau, for many, many years through his stellar leadership role in the Global Committee of Parliamentarians on Population Development, of which he is now our very distinguished and most admired and beloved chairman. He's chairman of the Global Committee.

We are delighted to have you here, Bruce. Please take five or 10 or 12 minutes, and then we may have a question or two for you now, but we surely will when we finish all the witnesses and get to general questions and answers.

And let me say, incidentally, that since we have suspended the formal hearing and we are operating now in an informal living room environment, there is no reason why any of you can't ask the witness questions, just as Congresswoman Schneider and I are asking questions. Let's really keep this informal and spontaneous and have some interplay between the wonderful people on this panel in addition to the interplay between the panel and the Members of Congress up here.

Bruce, take your five to 10 minutes, please.

STATEMENT OF BRUCE HALLIDAY, MEMBER OF PARLIAMENT, HOUSE OF COMMONS, CANADA

Mr. **Halliday**. Thank you very much, Mr. Chairman and members of your subcommittee. First of all, thank you for your kind words of welcome to your hearing today, and also if I might, on behalf of the Global Committee, thank you for the hospitality and the generosity which you have shown to all of us since we've been here in the last 24 hours or so. It is, of course, typical of you and we do appreciate that.

May I also at the beginning congratulate you and a few of your colleagues in Congress who have been so vocal and have kept the issue of population alive during these last number of years when there seems to have been a bit of a backing off on the part of the administration proper.

Mr. **Scheuer**. That surely is the masterpiece of understatement of the century.

Mr. **Halliday**. Well, I am a bit of a politician. I am often criticized as not being too practical. But I do just want to allude to that anyway, Mr. Chairman, if I might.

I want to, if I may, move on into my presentation, without reading it, of course. But before I do, I want to lead up to it by saying that I guess it was the famous historian Gibbon in the "Decline and Fall of the Roman Empire" who—I'm just paraphrasing him, but I believe he suggested if something doesn't continue to move ahead, it regresses.

I think that one of the big features of the Global Committee of which you have been such a stellar member over the years has been the fact that under the leadership of Akio and because of ourselves, we have moved ahead. If I could just review very briefly a bit of that history, because it is significant, I think.

I recall when we were first starting out as a group of parliamentarians and trying to gain interest around the world that we called ourselves parliamentarians who were interested in world population. That was the extent of our interest, population. But before long, within two or three years, we began to realize that you didn't talk about population alone in isolation, but you talked about development.

And so when we came to finalizing the name of our committee, our group, we became the Global Committee of Parliamentarians on Population and Development, which showed that we were enlarging our focus and enlarging our perspective.

I would suggest, Mr. Chairman, that we haven't stopped at that point either. I think the interesting thing is to consider that we are now moving into another era in the thinking of our group, where development in those days—and I well remember being, for example, in Sri Lanka, where somebody very proudly showed an airport runway or a road into the airport that was built by money supplied by the Canadian Government. I was proud to see it, naturally, and I'm sure that the Canadian Government and its officials were proud to be able to show that.

And this happened around the world with other items, other things such as dams and hospitals, and you could name a number of tangible items that you could point to, that governments had sponsored. And that was good and that was part of development.

But I think now that we are realizing that that's not development in its totality, or in its final essence as it relates to mankind or to human beings. So that with the onset of that economic decline that we have witnessed during the decade of the '80s, the growth of world debt particularly in the developing countries, we are beginning to see that the human factor has to come into this equation much more than the building of dams and the building of roads.

As a result of this economic decline, we are therefore seeing where a situation has arisen now where approximately one-sixth of the world population is suffering a decrease in its annual per capita income, where money being spent on education is actually decreasing on a per capita basis, where money being spent on health care and nutrition is decreasing on a per capita basis.

Mr. SCHEUER. Are you referring to the UNICEF, the recent thing they put out?

Mr. HALLIDAY. They certainly documented that very well, Mr. Chairman, and I think that it behooves us to take close note of that.

Mr. SCHEUER. Are you going to remind us that they attribute a great many of those reductions in budgets for social services, for health, for family planning, for job training, to the pressures of Third World debt that are pressing down on them?

Mr. HALLIDAY. I think I just mentioned that a moment ago; that it is that Third World debt, together with the economic decline over the globe during the 1980s, that has brought on these difficulties they have with respect to individuals' lives in terms of annual per capita income.

Monies available now, because of the debt problem, 25 percent of the revenue of the developing countries is going to pay off a debt instead of going to help education, help health care, nutrition, and so on.

So that as one thought about it, it came to my mind that I should present my paper today in the concept of a triangle. And I must say, Mr. Chairman, that none of the six of us at the table here have colluded or collaborated in our presentations, so you may get some overlap and you may get some very different approaches to the problem. But I hope you will bear with us in that regard.

So I entitled my presentation today The Triangle of Population, Poverty, Resources and Environment—combining those two together—and then to show how that relates to security, because security is an interest that all countries have, whether they are the United States of America or the USSR or any of our smaller countries or indeed a developing country, security is very important.

So might I suggest, Mr. Chairman, just to highlight my remarks, could I ask you if you have a copy of my paper in front of you, to turn to page 4. Page 4 is the one page that is not a narrative page and it's a diagram.

Mr. SCHEUER. Yes, I took note of that.

Mr. HALLIDAY. If I might just use my short time remaining just to explain the diagram and to use that as a send-off point for discussions that may develop as a result of what's in the paper.

The three points of the triangle are population, which as I mentioned earlier as the starting-off point for the Global Committee, in its very beginning was our concern for population. The other two points in the triangle are resources and environment, and the third one being poverty. And you can join those three together with lines, and you have an interesting triangle that highlights certain aspects of the total issue that we are trying to confront today.

But in the center of that triangle, I have just for purposes of convenience put the concept of security, because it is surrounded by these other three dimensions of the triangle. If I made a start with the one corner of the triangle, namely population—if you look at population and if you look at the diagram I have there, you will see that one arrow which goes from population down to resources and environment—that's one side of the triangle—says, and I am quoting, "Uncontrolled growth," that is, of population, "puts serious strains on resource base and threatens to breach the so-called carrying capacity of the globe.

So that's the influence that population has at one corner of the triangle on another corner; namely, resources and environment.

Let us move from resources and environment now up to the third angle of the triangle, namely, poverty, and we see the following: "Environmental degradation"—namely of our resources and our environment—"environmental degradation leads to poverty." One could discuss that in some detail and explain how that does happen, but I think that's an unchallengeable sort of comment that environmental degradation does now, we find and understand, lead to poverty.

Let's complete the triangle now and move from poverty to population and we find that poverty in Third World countries leads to rapidly-growing population.

Mr. SCHEUER. And environmental degradation.

Mr. HALLIDAY. Well, that goes on again around the circle. So, you see, we have a circle here that, unless you break it somewhere, it just keeps on going and gets worse and worse. It becomes a spiral, a vicious circle.

Now, let us just reverse our going on this triangle, reverse and go in the opposite direction. Again we'll start with population and we move towards poverty, and it says, "Population growth leads to increased poverty and undermines economy." Well, this is undoubtedly part of the problem in the developing world where we have excessive population growth leading to, as Brazil told us a number of years ago, leading to an absolute increase in the number of illiterates in spite of all the money they've spent on population. Hence, that conference in Brasilia, one of the reasons for it.

So I'm saying that population, going the other direction, leads to increased poverty and undermines the economy.

Again now, moving from poverty to the other angle, namely resources and environment, we find that the poor, those who are poor, suffering from poverty, they destroy the environment, as Sat Pau Mittal suggested regarding the trees on the mountains that you have observed. They destroy the environment in order to survive, ignoring the long-term effects.

And I am told that the famine in Ethiopia has occurred in a country where not too many years ago, 40 percent of that land was covered by forests and trees and now about 4 percent I believe is covered by forests and trees. So that we see, then, how poverty aggravates the whole situation by destroying resources and environment.

Then finally, Mr. Chairman, to complete the triangle again, we move from the resources and environment angle up to population, and we find that environmental degradation results in terrible human suffering, famine and death, which is a type of effect on population, lowering the quality of life which is a very important aspect of population indeed.

Now, if I may conclude then, Mr. Chairman, I think I've established how the concepts that the Global Committee is looking at now, the concepts of poverty, resources and environment, and population. How those three interrelate and contain in a sense this concept of security. Call it national security if you wish, call it international security if you prefer; it would affect all kinds.

And let me just highlight three aspects of that security issue which I think are of concern to all of us, no matter what country we happen to come from. And those three points would be this: that impoverished people support unscrupulous leaders who promise relief to them. So where you have a situation of dire poverty and increased population and degradation of resources, you have a perfect situation where unscrupulous leaders will play on the sentiments and on the emotions of those impoverished people and they take over the country and threaten the integrity of our political systems not only in that country, but sometimes in neighboring countries and indeed possibly around the world.

The second, I probably already alluded to it, is that uprisings in far isolated locales or countries nowadays become concerns of all countries. It's of international concern when you have something happening in any country in the world now.

Then, thirdly, under this concept of the importance of security, unchecked growth in population and environmental abuse threatens global security and our interdependent national economies.

In other words, we are now at a stage, Mr. Chairman, where in the United States of America you have for a long time thought you could be independent, as many of us have. But those days are long gone. There is no country now that can be independent for any length of time successfully. We are interdependent, and I think because of that we have to be alert to the fact that where there are problems anywhere around the globe, any country now has to be willing to pull its share of weight in terms of its economy and the facilities it has and its capacity to help out other countries.

So I just leave you, Mr. Chairman, and your committee and my colleagues with the suggestion that we do have a triangle now of poverty, population and resources which is playing a very important role in how the world is moving and how the populations are growing and how, in the final effect, how it does have a great bearing on the security of not only each of our countries but on the world in general.

[The prepared statement of Bruce Halliday follows.]

THE TRIANGLE OF POPULATION, POVERTY, RESOURCES AND ENVIRONMENT AND ITS RELATIONSHIP TO SECURITY

AN ADDRESS TO THE SUBCOMMITTEE ON NATURAL RESOURCES,
AGRICULTURE AND ENVIRONMENT OF THE COMMITTEE ON SCIENCE,
SPACE AND TECHNOLOGY

WASHINGTON, D.C.
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BY
DR. BRUCE HALLIDAY
MEMBER OF PARLIAMENT
HOUSE OF COMMONS
OTTAWA, CANADA

THE TRIANGLE OF POPULATION, POVERTY, RESOURCES AND ENVIRONMENT AND ITS RELATIONSHIP TO SECURITY

We speak metaphorically of the spaceship "earth" in order to emphasize the interdependence of people and the finite natural resources on which they depend. It is clear from the following status report that we can no longer ignore the limited carrying capacity of this planet to meet growing human needs:

* Every minute the global population grows by 150 and every year by 80 million. 93% of this growth occurs in developing countries. By 2000, world population will be at 6.1 billion. Half the world will be living in urban areas and 1/5 of these people will be living in mega-cities of 4 million or more.

* Some 1.2 billion people lack safe drinking water and 1.4 billion have no sanitary waste disposal facilities.

* Between 1950 and 1985 world cereal production increased by 2.7% annually to 1.6 billion metric tonnes. Even with a world grain stock of 300 million tonnes on hand, over 700 million people go hungry every day. To adequately feed the world by the year 2000, food production will need to increase annually by 3 to 4%.

* Only 4 billion of the world's 13.25 billion hectares of land are cultivable. The developing countries have half the cultivated land but contain over 3/4 of the world's population. Over the next 50 years to meet projected population increases, arable land will have to double as will yield.

*Although the industrialized countries contain less than 25% of the world's population, they consume 75% of the energy used, 79% of all commercial fuels, 85% of all wood production and 72% of all steel production. Overall, they consume about 80% of the world's goods, which leaves 3/4 of the population with less than one quarter of the world's wealth.

* Tropical forests are shrinking by 11 million hectares a year. Clearing the forest could consign more than 1 million species of plants and animals to oblivion by the turn of the century. Topsoil is being lost at the rate of 26 billions tons a year. New deserts are appearing at the rate of 6 million hectares a year.

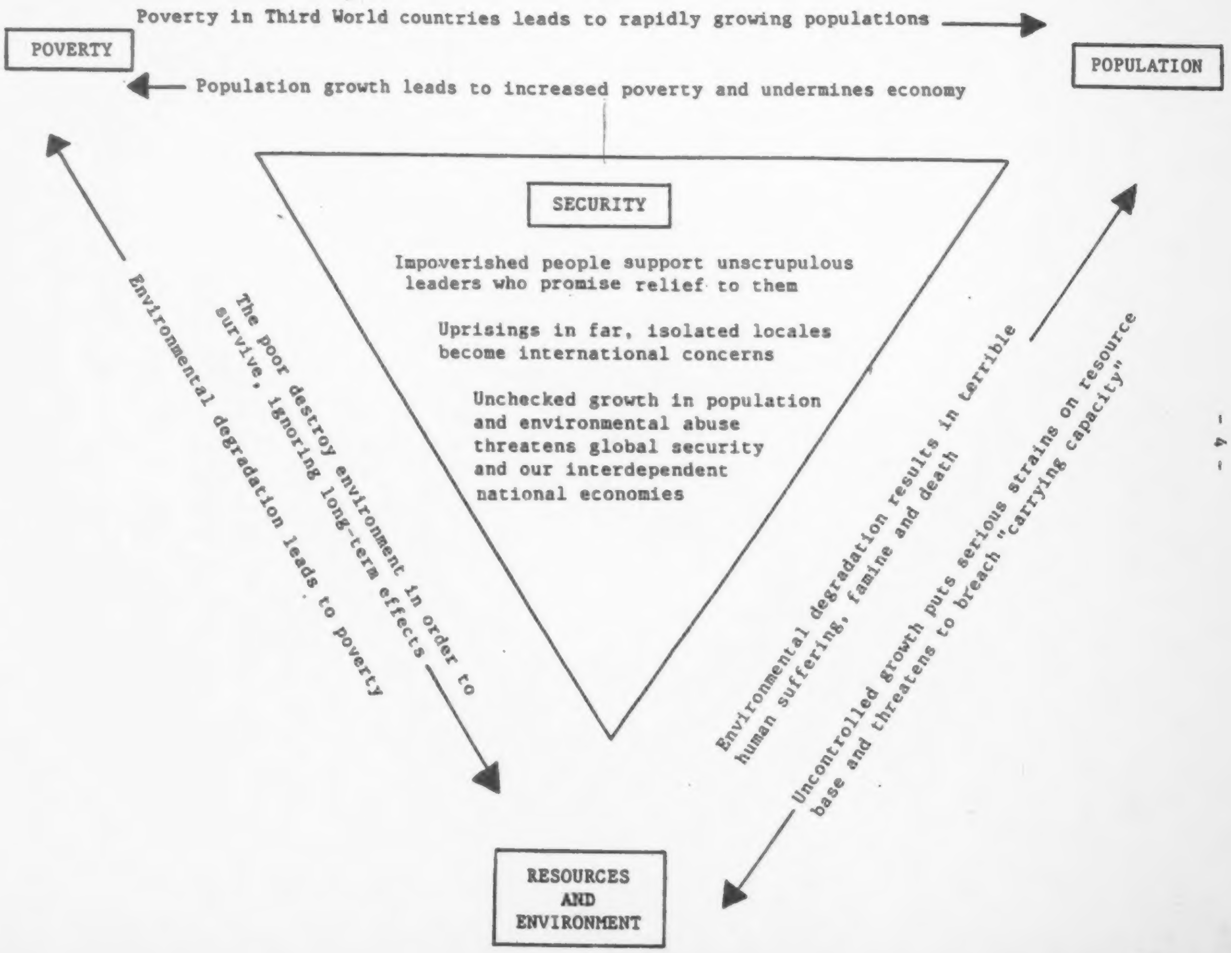
These are startling statistics but they have been gathered by international agencies which have responsibilities in the areas of population, resources and environment.

POVERTY

One of the most disturbing characteristics of our world is the drastic disparity in the distribution of wealth. Within the industrialized world there is a tremendous concentration of wealth, power, and technology. Yet there are more hungry people in the world than ever before. The differences between the quality of life in developed and developing countries arise from numerous contributing factors. Firstly, the unequal distribution of land in poorer countries worsens as environmental decline leaves less and less arable land for more and more people. Secondly, consider how much of the poverty in the Third World is caused by local factors and conditions, and the amount caused by over-consumption in and exploitation by the developed world. For decades, our response to this situation has been to contribute money and aid with the hope that the problems would be alleviated. However, the inadequacies of that approach have become quite clear. A recent caveat from Mr. J. Makhan Dube, honorary president of a Canadian branch of Global Village, an international education agency, suggests that in our attempts to combat poverty, we have neglected an important point:

> Foreign aid agencies too timid to bypass unjust social, economic, and political structures in the Third World are guilty of prolonging misery and suffering. Only by unswerving dedication to the evolution of democracy, to the empowering of people through their own organizations, can aid agencies make any permanent impact on human suffering.

Additionally, it is apparent that dealing with poverty must include a broader appreciation of its link to population, resources and environment, as the diagram found on page four attempts to illustrate.


POVERTY
POPULATION
Poverty in Third World countries leads to rapidly growing populations
Population growth leads to increased poverty and undermines economy
SECURITY
Impoverished people support unscrupulous leaders who promise relief to them
Uprisings in far, isolated locales become international concerns
Unchecked growth in population and environmental abuse threatens global security and our interdependent national economies
Environmental degradation leads to poverty
The poor destroy environment in order to survive, ignoring long-term effects
Environmental degradation results in terrible human suffering, famine and death
Uncontrolled growth puts serious strains on resource base and threatens to breach "carrying capacity"
RESOURCES AND ENVIRONMENT

When the concept of our earth as a finite system, where one country's resource benefits become another nation's pollution risks, was first postulated over 20 years ago, author Kenneth Boulding warned even then:

> ... It may be said, of course, why worry about all this when the spaceman economy is still a good way off (at least beyond the lifetimes of any now living), so let us eat, drink, spend, extract, and pollute, and be as merry as we can, and let posterity worry about the spaceship earth ... should we just go on increasing the GNP and indeed the gross world product, or GWP, in the expectation that the problems of the future can be left to the future, that when the scarcities arise, whether this is of raw materials or of pollutable reservoirs, the needs of the then present will determine the solutions of the then present, and there is no use giving ourselves ulcers by worrying about problems that we do not really have to solve? ... As an old taker of thought for the morrow, however, I cannot fully accept this solution; and I would argue, furthermore, that tomorrow is not only very close, but in many respects it is already here. The shadow of the future spaceship, indeed, is already falling over our spendthrift merriment.

It seems that Mr. Boulding's prognosis was restrained in the light of today's world picture. The shadow of the present spaceship is resting on us. As Margaret Catley-Carlson, the President of Canada's principal international agency, CIDA (Canadian International Development Agency) has said in February 1988:

> We are already putting a heavy load on our environment. The signs of strain seem to grow daily. We see it here at home in our concerns about acid rain and other forms of air and water pollution. Our problems are serious and we can't afford to be complacent about them. But developing countries are facing environmental crises that are even more serious than ours -- much more direct and profound.

But just what are we doing to increase our awareness of the gravity of the situation and to promote national and international strategies to alleviate it?

RESOURCES AND ENVIRONMENT

The message of the World Commission of Environment and Development, the Brundtland Commission, has focussed attention on the need for "Sustainable Development". The Commission was asked by the General Assembly in December 1983 to formulate a global agenda for change. The prescription for change entitled, Our Common Future, was released in 1987.

"Sustainable Development" is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It gives priority to the world's poor and defines economic and social goals within the earth's ability to sustain them and within the environment's carrying capacity. It provides objectives to better match people's needs and planet limitations. Sustainable Development involves reviving economic growth but within sustainable limits given that in any case stagnation won't prevent our polluting ways. We need this growth to meet essential needs for jobs, food, energy, water and sanitation. Living standards above the basic minimum are sustainable only, however, if consumption standards everywhere have regard for long-term sustainability. Yet many of us presently live beyond the world's ecological means, so we need to encourage consumption standards that conserve and enhance the resource base. Population numbers slow the rise in living standards in areas where deprivation is widespread. Sustainable development can only be pursued if demographic developments are in harmony with the changing productive potential of the ecosystem.

Considering that much resource degradation stems from excessive human pressures on the land, reversing this trend requires a significant slowing of population growth. Current data show that if growth rates persist, Africa will need to support an additional 263 million people by the year 2000. The Population Reference Bureau (PRB) has stated, "No matter how much funding comes forth, or how fast effective technologies spread, or how diligently governments implement land reforms, a lasting victory over land degradation will remain out of reach until population pressures ease". We are told a 5 to 10-fold increase in economic activity will be required over the next 50 years if consumption in the developing countries is to be raised to equitable levels. It is true that biotechnology is a timely addition to the scientist's tool kit -- to speed the pace and the potential return on investment in agriculture, for example -- but it does not promise dramatic production gains. The present scale and pace of development will result in a continuing draw-down of the earth's basic environmental capital. If this continues, the growth needed will not occur and all nations will suffer the effects of a depleted environmental resource base and global economic decline may ultimately be inevitable.

POPULATION

The effectiveness of the required economic growth will depend to a large extend on population numbers because the imbalance between food and population growth implies continuing widespread malnourishment, poverty, high mortality rates and shortened lifespans. As the United Nations Fund for Population Activities (UNFPA) points out in The State of World Population 1988, the pace of population growth and population distribution strongly influence the use of agricultural land, energy resources, vital watersheds, and forest areas.

Uncontrolled population growth in subsistence economies is degrading the resource base throughout Africa. Breaches of carrying capacity thresholds are also commonplace in the Indian Subcontinent, Central America, the Andean countries, and Brazil. Attempting to slow population growth quickly when living standards are deteriorating is one of the most difficult, politically complex undertakings any government can face. Many nations face a demographic emergency. Failure to check population growth will lead to continued environmental deterioration, economic decline, and may eventually lead to social disintegration.

We are already seeing evidence of countries which are not necessarily richly endowed with natural resources, but which, by slowing population growth, are improving wealth, literacy, health, nutrition and stability. As the UNFPA emphasizes, these countries pay more attention to rural development and especially to stemming unplanned urban growth, which is an urgent problem that cannot be ignored. They demonstrate a commitment to social as well as economic development, particularly as regards women who are better incorporated into the mainstream of economic development. Data from around the world show that as female education, health, employment, and legal rights improve, birth rates decline. Large families are frequently a sign of the subordination of women. Countries which have made notable progress in these areas are Costa Rica, Malaysia and Fiji.

The developing countries can do only so much. They need assistance in funds and technologies to spur their economic growth in beneficial directions. The industrialized world has reduced poverty and rate of population growth, but at great expense to the environment. This should not be necessary in the Third World if appropriate technologies are transferred there. To the poorer nations where poverty and population numbers are shrinking the ability to sustain life, industrialized countries need to provide assistance to solve population and other problems, as part of the search for sustainable development.

As the Worldwatch Institute publication, State of the World 1987 points out:

> In just over half the world, time is running out in the effort to slow population growth by reducing birth rates. Unfortunately, not all national leaders recognize the basic relationship between population growth, ecological support systems, and economic trends. Even those who understand the links do not consistently support effective family planning programs. Perhaps the most tragic failure in this area is the United States. Traditionally a leader in the international family planning movement, the U.S. government announced in August 1986 that it was withdrawing all financial support from the UNFPA.

We should ensure that organizations such as the UNFPA and the International Planned Parenthood Federation (IPPF) are supported by the developed world in their efforts to address population growth and structure, and implications for the environment and sustainable development. Yet many of our present economic, trade, agricultural, energy and development assistance programs still actively encourage unsustainable development.

We should be able to learn from our own mistakes in the industrialized world. Farm support programs are a case in point. These programs have risen from $2.7 billion in 1980 to $25.8 billion in 1986 in the U.S., and in the EEC from $6.2 billion in 1976 to $21.5 billion in 1986. According to informed observers, these heavily subsidized production systems have produced surpluses and encouraged the overuse of soils and chemicals, and degraded once fertile countryside. We choose to send our surpluses to the developing world at reduced prices, often undermining the farming policies in those countries. However, the situation in many developing countries requires intensification of agriculture based on respect for soil, water and forests. Application of technologies has been difficult where farmers are not sufficiently supported. Re-design of subsidy programs could not only provide income support for those farmers, but also encourage practices which enhance soil and water conservation and prevent the needless destruction of precious forests.

THE CANADIAN PERSPECTIVE

In early 1987, the Government of Canada adopted as its aid priority the development of local skills to assist recipient countries to solve their own problems. In the spirit of the Brundtland Report, this approach is being promoted by Canada's research aid arm, The International

Development Research Centre (IDRC). Small-scale but improved production systems, crops of higher nutritional value but suited to local conditions, and the integration of land and water resource management into agricultural planning demonstrate the direction of assistance on the part of IDRC, which we hope will lead to sustainable agriculture in the future.

In its assistance policies, Canada has adopted a definition of development by which countries meet their basic needs based on the long-term sustainability of their indigenous resources. During 1986-87, over 1/4 of all Canada's bilateral assistance projects had an environmental element, designed to strengthen conservation practices, improve the management of natural resources, or rehabilitate the environment. Environmental destruction often results from the desperate search of the poor and the landless for basic needs of fuel, food and water. As writes Shridath Ramphal, British Commonwealth General Secretary:

> Poor people often destroy their own environment -- not because they are ignorant, but to survive. They over-exploit thin soils, over-graze fragile grasslands, and cut down dwindling forest stocks for firewood. In the context of the short-term needs of an individual, each decision is rational; in a long-term and wider

> context, the effects are disastrous ... Poverty is both a cause and an effect of environmental degradation.

Thus, programs focus on re-establishing an ecological and social balance through stabilizing the vegetation cover or restoring the food balance, as CIDA is doing in the African Sahel.

There are conservation and land management projects in China, India, Pakistan, Columbia and Brazil, and water agricultural projects in Bangladesh, China, India and Pakistan. Most of CIDA's integrated rural development projects contain a reforestation component. Initiatives to improve drinking water and sanitation are underway in Guatemala, Honduras, Peru, Nicaragua, Guyana and the Leeward and Windward Islands.

Women have become the focus of much of Canadian Development Assistance since, in the developing world, over 80% of the food for domestic use is grown by women. A "Women In Development" policy was adopted in 1984 to help women benefit from Canada's development assistance program. The emphasis is on training women in new development skills and encouraging governments to increase women's participation in development projects. And, in a similar move to increase the social consciousness of development, Canada takes human rights records into account when assessing any development assistance mechanism.

These are just some of the actions the Canadian Government is taking towards sustainable development and the protection of our planet. As the United Nations Fund for Population Activities cautions:

> Political and economic agendas must take account of the need to conserve the planet's ecological 'capital' and to pay for development from the 'interest' - the sustainable husbandry of resources.

SECURITY

There exists another important approach when considering the effects of development on our national and international security. Uprisings and conflicts half-way around the world threaten everyone's security, a fact which has become inherent to our modern existence. Some of the most volatile places in the world are home to poor and desperate people with nothing to lose by throwing their support behind anyone who promises them food, land, health care and education. The impact of their actions on policy-makers in Washington or Ottawa mean little to them because when their children are hungry, nothing else really matters. When a nation is unable to meet its resource needs from its own resource base, its problems spill over and become a world security problem. The effects of resource use, environmental damage and population growth are not confined within national borders but pose a threat to the integrity of the whole planet, not just to any one nation. For example, some people suggest that we are already witnessing the disastrous effects of environmental degradation on our global climate.

Another aspect of the political security question is the fact that foreign aid can help to ease tensions within communities by uniting people at a grassroots level in common causes. Where the availability of natural resources required for the basic needs of survival is in short supply, conflicts can arise over resource ownership. The politics of water supply, arable land and forest do not always involve rational discussion and negotiation. They are more likely to produce conflict. However, if aid projects are properly managed and local groups co-operate to get the job done, there will ultimately be less conflict and work and food for all. That is the difference development can make. If one more village is at peace and striving for a future of self-sufficiency, that is one less trouble spot on the globe for us all to worry about. Alan B. Durning comments in the Worldwatch Paper 88, Poverty at the Grassroots:

> Over the long run, bonds between local groups struggling against poverty and groups struggling to safeguard natural resources are likely to grow stronger. More organizations will come to terms with the fact that the environment can suffer because people have too much or because they have too little. And more people will understand that the interdependence of the earth's life support systems turns local problems into global ones. As Shridath Ramphal writes, "Neither the excesses of wealth not the excesses of poverty can be quarantined".

This final linkage between security and development concerns the international economy. Third World countries are up to their neck in debt. The circumstances have become desperate because not only are they bankrupt with no obvious way out, but their bankruptcy threatens to drag us all with them. It is clearly in our national self-interests to do everything we can to help these countries improve their situation. Not only money is required. What most of them need is expertise, technical know-how, and support to create a thriving private sector of their own, without which developing nations may never recover from their crushing debt load.

The security of our own economies is at stake. As we increasingly rely on the Third World as a trading partner, it also becomes important to keep their economies growing. The North-South Institute in Ottawa estimated that the downturn in Third World economies over a three-year period during the global recession of the early 1980's cost 135,000 jobs in Canada alone. It is therefore important to recognize our interdependence, for we are not only a Global Village in the political and strategic sense, but we are also bound together by basic economics.

CONCLUSION

Having examined the complex effects which poverty, population and the environment have on one another and our security, the urgency of our actions should be strikingly clear. The consequences of inaction may not appear in our lifetime, but we have a responsibility to future generations to implement sustainable human progress. Mr. James P. Grant, Executive Director of UNICEF stated at the Global Forum of Spiritual and Parliamentary Leaders at Oxford, England in April 1988:

> In any civilization, morality must march with capacity. Those whose social domain involves the human conscience as well as those who govern societies must assert unequivocably that it is now unacceptable for so many millions of children to die of needless malnutrition and infections. The mass deaths of children must be placed alongside slavery, racism, colonialism, and apartheid on the shelf for those things which are simply no longer acceptable to humankind.

Further, in a similar statement, American astonomer Professor Carl Sagan warns that the situation commands our committed attention when he says, "We live on one planet, one lovely world which, as far as we know, is the only possible home for humans, the only world graced by life. This world clearly needs to be cherished and preserved."

Mr. **Scheuer.** Bruce Halliday, thank you very, very much for your testimony. We appreciate it very much, and your paper was truly outstanding.

We have been joined by Congressman Lamar Smith who is a freshman member of this committee, a sophomore Member of Congress, and he opted to come on this committee. We are delighted to have him and he has proven to be a very hardworking and contributing member.

All right. We will now move along to Minister David Kwidini, Minister of Youth, Sports and Culture from Zimbabwe. He is also Secretary-General of the Global Committee of Parliamentarians on Population and Secretary- General of the Africa Parliamentary Council on Population Development.

So, Minister Kwidini is playing not only a critical role within the confines of Zimbabwe, which is one of the most successful countries in sub-Saharan Africa in the establishment of far-reaching, pervasive family planning programs, but he is also a force, a positive constructive force throughout the length and breadth of sub-Saharan Africa on family planning and other population-related issues.

We are delighted to have you, Minister Kwidini. Your entire set of remarks will be printed in full at this point in this little informal colloquium, and so we ask you to take five or 10 minutes, and then I am sure when we finish the other two witnesses, we'll have some questions for you.

STATEMENT OF DAVID J. KWIDINI, MINISTER OF YOUTH, SPORTS AND CULTURE, ZIMBABWE

Mr. **Kwidini.** Thank you, Mr. Chairman.

I'd like to take this opportunity to thank you for having invited me to take part in these informal hearings and also to have given us a very interesting and exciting dinner yesterday at which we met your wife.

Mr. Chairman, I found Bruce Halliday's triangle very intriguing indeed. It is a triangle that turns into a vicious circle. I don't know how long ago Bruce went to secondary school, probably a little earlier than me, but my mathematics then taught me that a triangle is 180 degrees but his triangle happens to be a vicious circle, which is 360 degrees.

However, the point I am making is that I find it very interesting because it represents situations in many parts of the world. It does represent the situation in my own country, Zimbabwe, and very well sums up, I think to a large extent, situations in many other developing countries.

Mr. Chairman, I can only speak confidently on the experience we went through in Zimbabwe. I can speak confidently on what I know to be the position in Zimbabwe. To make generalizations that pertain to the continent as a whole of Africa would probably be not quite correct. But I think by and large the remarks which I will make which relate to Zimbabwe relate also to any parts of our continent, the African continent.

Certainly in Zimbabwe, as probably in other parts of Africa now, there is a realization and a recognition of the problem of population and how it relates to development, development in the complete sense of the term. Be it in the area of food production or provision of employment or provision of social services, there is no way one can separate the issues of population, especially rapid population growth, from those segments of development we have mentioned.

It is being recognized more and more that population is at the center of all development issues, is at the center of development policies and programs.

The argument we heard 10, 20 years ago in Africa and probably still maintained in some parts of Africa today, that Africa is a vast continent with large tracts of unoccupied land, that argument does not hold water anymore because it is clearly known and has been established that the vast tracts of land contain a small portion of fertile land suitable for agriculture. The bulk of it is either arid wastes, deserts, or rocky terrain which is of no use or very little use to the inhabitants of the continent.

And that small proportion of good land is generally overpopulated in the sense of densities, overused, overgrazed, and if there are any woods at all, the woods are cut down for fuel and other uses.

So this leaves, then, even the small proportion of good land reduced in viability, and therefore the argument that Africa enjoys vast unoccupied lands does not hold much conviction anymore.

Less and less land is becoming available to the new generation. Most of the African countries have a practice of passing on land, the older generation passing on land to the new generation, because by and large many countries have what we call in Zimbabwe communal lands, not purchased lands, but lands that have been demarcated for the use of communities.

Now, whereas perhaps 40, 50, 60 years ago much of that land was adequate for the uses of the communities, today with fast-growing populations, less and less land is becoming available to the populations as a whole. And that has had its effects on agricultural production.

There is also the real problem of droughts. The African continent is experiencing more frequent droughts now than it has ever had before. It is difficult to say exactly why. Perhaps the reason, the scientific reason that has been given, that so many forests have been cut down, may be an explanation why the rainfall patterns have become more and more erratic. The vegetative cover has been destroyed, and that also has an effect on rainfall patterns.

So this, therefore, is bringing a decline of agriculture, and there is less certainty from year to year whether the rainfall will come and enable people to cultivate and get the necessary agricultural produce.

The rivers, the dams, and lakes have been silted at a very fast rate. This is true of my country and I think it is true of many African countries, and this also is endangering the sources of water. Water is becoming difficult to obtain and in some areas people have got to travel long distances to get their water supply.

All this adds up to the fact that we are experiencing greater poverty because agriculture is no longer as productive as it should be.

Because of these real problems, there is therefore a recognition in many African countries today that there is a need to control rapid population growth, there is a need to put in place programs and projects which address environment problems by way of technological management of the land and by bringing into place conservation strategies to arrest the deterioration of the land and also to increase food production.

In my own country, preventive measures have been taken or initiatives. In the area of population, we have, I think a very successful, probably one of the best family planning services. These have been expanded to cover the entire country and they are bearing results. There is a 33 percent acceptance rate of family planning methods. There is an 80 percent rate of awareness amongst women of the various contraceptive options that are available to them.

Mr. **Scheuer.** What accounts for the difference? Eighty percent of women understand the various contraceptive options available to them and a third of them practice some kind of contraception. So there's between 33 or 4 or 5 percent and 80 percent, you're talking about 45 percent.

What is the problem there? Is it they feel that they don't want to engage in family planning? They don't want to limit their fertility?

Mr. **Mittal.** No. That shows the rate of awareness and rate of acceptance. That shows the difference between rate of awareness and rate of acceptance.

Mr. **Scheuer.** Yes. And I'm asking what explains the difference.

Mr. **Kwidini.** Yes, I think I can explain that. Part of the reason is that whilst there is an awareness, there is the real fear which still exists because mortality rates among infants are still very high.

In Zimbabwe at least we can talk about a reduction, a visible reduction in mortality rates for infants. At the present moment it is something like in the order of 96 deaths to 1,000.

One of the things I can say is that family planning as a method of population control is a new idea. It has got to develop. We cannot expect 100 percent success already, or 80 percent success with it. And if you compare the Zimbabwean experience—that is, there is a 33 percent acceptance of family planning—with what happens elsewhere in Africa, we have a much higher acceptance rate than anywhere else in Africa.

Mr. **Scheuer.** A 33 percent acceptance rate is high for all sub-Saharan Africa?

Mr. **Kwidini.** It is much higher, in fact, probably the highest of most of the African countries. So there is a growing rate. It may not be satisfactory, but certainly there is movement towards acceptance of family planning services.

Ms. **Schneider.** Mr. Kwidini, if I might ask a question. I had the opportunity to represent the United States a couple of years ago in Kenya for the International Decade on Women Conference that the United Nations sponsored.

And let me say that the representatives there from Zimbabwe were outstanding and I certainly commend you and your country for the leadership that you have provided in providing more information, improving literacy, and certainly addressing the problems of population.

One of the things that we did, and the Chairman was enlightened enough to hold hearings of this type last year, at that time we found that when it came to the pressures on the environment, that women for the most part in Africa are the farmers, that 80 percent of all agriculture is produced by women.

Mr. **Kwidini**. True.

Ms. **Schneider**. But we were finding that the women were the ones that were cutting down all of the trees. They were leading the ones responsible for the erosion, the desertification, and essentially to the starvation that was taking place in Africa.

What was interesting to me is that the women at the United Nations Conference said we want America to provide us with information on how we can do things differently. Well, we came back here, the chairman held a series of meetings and hearings, and we concluded that one of the things that we ought to do is to earmark some of the AID money for the Agriculture Extension Service programs. But we found out that women, who were doing most of the agriculture, could not take advantage of our foreign aid money because the women couldn't read.

Mr. **Kwidini**. That's illiteracy, high illiteracy.

Ms. **Schneider**. That's the high illiteracy rate. So therefore the women are doing the farming, using the wrong techniques. We are giving aid, and we are not really helping solve the problem, we are not helping the country, we are not helping the families, and we are not helping U.S. taxpayers because they are not getting their money's worth either.

Well, what was interesting, in an effort to pass this legislation that would require that we earmark our AID monies and target it toward women in agriculture, I had a very difficult time with the African ambassadors. And I think it gets back to what Mr. Mittal is saying, that he is suggesting that the equality of women throughout developing countries is moving, but there has to be more of an assertion on the part of those men in power to raise the status of women because in terms of developing foreign policy here in the United States, it's difficult for us to say you must target these monies toward women, when the recipient countries are saying, "I'm sorry, we don't want women to receive those agricultural monies."

Mr. **Kwidini**. Our Zimbabwean record will show that we have put massive investment into education. At the present moment—well, let me say we have made education a right for every child. We have made education available, and in fact a great deal has been done to make it available to every child.

Today in school, if you go to primary schools—I'm not talking of secondary school education—there are still disparities there, there are still disparities also at university—but certainly in primary school settings, you will be impressed with the numbers. They are equally balanced in terms of sexes, between male and female. We have given this emphasis to underline our own policy of equality of opportunity in order to raise the level of literacy, because we realize that is fundamental to development.

Ms. **Schneider**. Well, I commend your country and certainly admire the leadership that you have taken, but my bottom line message is, I hope you will try to convey that same type of policy position among the other African nations, because I think it will be easier for us as policymakers to justify foreign aid if we can guarantee that there is a raising of consciousness and a shift in policy that hadn't been there in the past.

So we will work with you as a team member and we look forward to that kind of movement.

Mr. KWIDINI. In fact, I'll say it is part of our function as the members of the Africa Parliamentary Council, we are actually speaking to parliamentarians, they are the people that are members of our organization, and the message is being put across.

But if you are looking at development, it has got to be development in its totality. If you're looking at questions of population, you've got to look at the questions of education, improving health services, ensuring that food production goes up, and that all development has got to be related to the question of balancing between population and the environment and food production.

I can't say we will have the results tomorrow. It's been a very slow process, but eventually we will probably get there.

Ms. SCHNEIDER. Good. Thank you.

Mr. SMITH. Mr. Chairman, if this would be an appropriate time, I'd like to ask a question as well.

Mr. SCHEUER. By all means.

Mr. SMITH. I would like to relate Mr. Kwidini's earlier comments, before he answered the questions of my colleague from Rhode Island in regard to birth control, and try to relate those to the testimony submitted by Mr. Halliday.

Let me read a couple of excerpts that I happen to agree with. On page 11, you mentioned the need to address population growth in structure. On the last page, you quote Mr. Grant from UNICEF as saying, "It is not acceptable for so many millions of children to die of needless malnutrition and infections."

I relate those two and put them together in many, many ways. I just wanted to ask before we leave this subject that was brought up by Mr. Halliday and Mr. Kwidini if, Mr. Halliday, you had any suggestions, any recommendations that you would like to mention as to how we might encourage population control.

Mr. HALLIDAY. Well, I think if one addresses the issues of poverty, you address those by taking care of a number of factors. You address the aid and direct the aid to organizations at the local level, who are geared to cooperate and work with the individuals in that community.

If you can improve the economic well-being of people, you are therefore going to end up with a lesser growth and growth in population, they will be more affluent, they will become educated and so on. All these factors will, if you combine those factors with the availability of family planning techniques, you then end up, I think, with an opportunity to have a significant input into lowering the population growth rate.

Mr. SMITH. Thank you. Thank you, Mr. Chairman.

Mr. SCHEUER. Minister Kwidini.

Mr. KWIDINI. If I may quickly sum up the points that I was raising, that we have in place a number of programs that address themselves to health services, which we have expanded immensely over the past 10 years, making health services available to the majority of the people in Zimbabwe, also helping to reduce the mortality rates especially amongst infants; making health services available so as also to enable the family planning services to be easily accessible to as many people as possible. And this partly explains the 80 percent awareness which I talked about earlier; the fact that family planning services are more easily accessible to as many people as possible.

Mass education, certainly I have talked about and I have said the strategy is to raise especially the literacy amongst women, because we believe at the end of the day, literate women will be more amenable to ideas of family planning.

As to the problems of environment, especially the need for having programs to protect the environment, we have brought in place a number of programs and projects such as afforestation programs, programs for gulley reclamations, programs for contour ridging so as to protect our soil and arrest the deterioration of our land resources.

Finally, Mr. Chairman, I would like to suggest that whatever we do in our individual countries, the success of programs or projects, especially in the area of environment, will depend also on the cooperation at the international level of various countries, especially neighboring countries.

In our situation, we have in place a number of environmental programs on which we are working together with the rest of the countries, because some problems, especially those that relate to siltation of rivers, are not only national; they are actually problems that affect neighboring regions and therefore it is necessary to have in place cooperation in those programs which can be shared between governments.

Thank you.

[The prepared statement of Mr. Kwidini follows.]

THE POPULATION AND FOOD EQUATION : THE ZIMBABWE EXPERIENCE (A DISCUSSION PAPER FOR THE CONGRESSIONAL HEARINGS OF THE SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE RESEARCH AND ENVIRONMENT OF THE COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY, MARCH 2, 1989, WASHINGTON D.C.) BY D.J. KWIDINI M.P., MINISTER OF YOUTH SPORT AND CULTURE : ZIMBABWER, ALSO SECRETARY GENERAL OF THE GLOBAL COMMITTEE OF PARLIAMENTARIANS ON POPULATION AND DEVELOPMENT

The majority of governments in sub-Saharan Africa have come to realise through painful experience that blueprints for development are invariably vitiated by the vast and all-pervasive problem of rapid growth rate of population. The national desirables such as employment, food, health, shelter and education for all have become mirages which are always elusive from the grasp of governments of the developing region of Africa. I think we are all agreed on the premise that population is an asset for any country. But when the size and growth rate of the population exceed the ability of any nation to sustain the desired levels of the quality of life of its people, then population instead of being a source of strength becomes a source of weakness. This premise is now well recognised by many governments of sub-Saharan Africa as witnessed in their declaration of the Kilimanjaro Programme of Action on Population made in 1984 In that declaration they urged that "population should be seen as a central component in formulating and implementing policies and programmes for accelerated socio-economic development plans"

Many arguments have been advanced by protagonists for the control of the growth rate of African populations. Equally vehement have been the arguments of the devil's advocates who have insisted that the problem of population in the context of Africa is a figment of the expert's imagination. They quote examples of vast tracts of land which are unoccupied by humans and they derive comfort from the fact that the most populous nations of the world are in Asia - vast populations which make African populations look like the populations of their small cities.

But where does the truth lie, in respect of Africa, in this welter of arguments? I think it is a well-established fact that the vast tracts of land that Africa may boast of are mainly arid wastes or rocky terrain that yields little or no production. Most African countries experience unacceptably high levels of poverty, unemployment particularly among the youth and school leavers, increasing population pressure on a small proportion of good land, over-grazing, deforestation and siltation of rivers, lakes and dams with their concomitant effects on rainfall patterns. These problems have been compounded by intermittent droughts and a world economy that is prone to high fluctuations of commodity prices for especially agricultural and mineral products with which Africa is well endowed. The effect of all these factors on Africa's fragile economies is serious. Moreover,

Africa has, in the past decade or more experienced a declire in agricultural production. Whereas agricultural production in sub-Saharan Africa grew at the rate of 2.5 per cent per annum in the 1960s, this growth rate declined to 1.4 per cent in the 1970s.

The contrast of this agricultural decline is the growing numbers of mouths to feed. The GDP of many African countries is growing uncomfortably too slowly. Very few sub-Saharan countries, if any, have been able to sustain a GDP of 5 per cent per annum. In contrast most African countries are experiencing a burgeoning of their populations which are increasing at the rate of 3.0 per cent. This preponderating population growth rate over the GDP is not helping Africa to improve per capita incomes. In contrast, other regions of the developing world, especially Asian countries with slower population growth have experienced increases in per capita incomes.

The argument, therefore, is that there is a case for doing something urgently to slow down the growth of our African populations. Sufficient facts have been adduced by many demographers who have examined the African situation to make us all feel concerned about the problem. "While the causes of rapid population growth are in part rooted in cultural and religious values which expose the virtues of having many children for a variety of reasons, poverty conditions tend to breed abnormal population growth rates," says Dr. B.T.G. Chidzero, Senior Cabinet Minister of Finance of Zimbabwe. "What is required here," he says, "is imaginative and systematic population planning. We cannot continue to pull wool over our faces in this regard".

RECOGNITION OF THE PROBLEM BY THE ZIMBABWE GOVERNMENT

From the foregoing statement made by the Senior Minister of Finance, Economic Planning and Development, Dr. Bernard Chidzero, it can be seen that the Zimbabwean Government and political leadership is extremely concerned about the problem of rapid population growth. In its First Five-Year National Development Plan 1986-1990, Volume 1, the Government of Zimbabwe stated that it attached high priority to the creation of new employment opportunities. It, however, acknowledged the fact that cognizance had to be taken of the rapid growth rate of the population of working age, 15-64 years. In 1985 this age group stood at 4,2 million persons or 50 per cent of the entire population. It was expected to increase to 5.0 million or 54.0 per cent by 1990. It was in recognition of this fact that the Government committed itself, in the National Development Plan, to continued support of the extension of family planning services to all parts of the country in order to further reduce population growth to levels consistent with economic growth and the objective of raising the living standards of society. This represented a clear, unequivocal, statement of policy on the issue of rapid population growth. Before 1985 and since then, various projects and programmes have either been expanded or initiated.

TABLE I

ESTIMATED GROWTH OF ZIMBABWEAN POPULATION

(Average annual growth rate in per cent)

	1982-1985	1985-1990	1990-1992
Male	2,86	2,79	2,67
Female.......	2,80	2,72	2,61
Total........	2,84	2,76	2,64

Source: Population Projections, Medium Variant, C.S.O., December 1985

TABLE II

POPULATION BY BROAD AGE GROUPS 1982-1992

(In thousands)

Age group	1982	Per cent	1985	1990	1992	Per Cent
0-14 years	3553	47,3	3 745	4 027	4 130	41,8
15-64 years	3733	49,7	4 197	5 097	5 488	55,6
65+ years	231	3,0	233	245	252	2,6
TOTAL	7517	100,0	8 175	9 369	9 870	100,0

Source: Population Projections, Medium Variant,
C.S.O., December 1985

THE FAMILY PLANNING PROGRAMME

The family planning programme is the direct responsibility of the Zimbabwe Family Planning Council (ZNFPC) which was legally constituted as a parastatal organisation in August 1985. It has a Board of 18 members, representative of Zimbabwe's economic, administrative and socio-cultural structures. Each of the 8 provinces of the State has a Family Planning Committee which provides an advisory service to the national body. This national and provincial structure attempts to ensure that all areas of the country are reached by the family planning services through a network of health centres, clinics and hospitals. At the time of the setting up of the Family Planning Council, Government directed that the Council should do more than confine itself to child spacing for health considerations. Government saw it as the Council's responsibility 'to alert the nation to the need for limiting family sizes, with a view to reducing the rate of growth of our population to a level that makes possible the raising of the standard of living of our society' and is compatible with the country's socio-economic development.

The ZNFPC has built up a highly successful family planning programme over the past 5 years. Informed observers believe that Zimbabwe has probably the highest contraceptive prevalence rate in sub-Saharan Africa. The family planning programme has achieved a contraceptive prevalence rate of 33 per cent. It is estimated that about 80 per cent of all Zimbabwean women in the child-bearing age knows at least one family planning method. There are indications that fertility is declining.

It is proper and also fitting to state here that this programme has been given by Government the priority it deserves and the American assistance through USAID is acknowledged by the Zimbabwean Government with sincere gratitude. I am informed that USAID has disbursed over the past 8 years US$6,3 million on this project alone and more assistance continues to come from this source.

THE MASS EDUCATION PROGRAMME

Family planning programmes cannot alone achieve the desired objective of tackling successfully the intractable problem of rapid population growth without other support services. Educaton, especially for women, plays a vital role in the reduction of fertility. Literacy for women, it has been claimed, is one of the most effective forms of contraception! The argument is that mass education tends to prevent early marriages. Girls and boys are kept longer in school. By the time they complete secondary education, they are older and mature and they are more likely to undertake professional courses which further delay their natural inclination to get married and/or to have children. Education does influence a reduction on fertility.

From the time of independence in 1980, the Zimbabwe Government decided on a massive education programme which gave every child the right to education. From a mere 800,000 children in school in 1979, Zimbabwe now boasts of over 3,3 million children in primary and secondary education out of a population of about 8.5 million. This policy of mass education is bound to have a positive effect on the birth rate of the country in the long term. Certainly, it is keeping most of the children longer in school, with its attendant effect on the reduction of fertility of the womenfolk.

HEALTH FOR ALL

A great deal has been done in the provision of health services in Zimbabwe. As in education, the Zimbabwe Government has made the attainment of health for all by the year 2000 a priority. Significant strides have been taken in reducing infant mortality. The infant mortality rate is now about 76 deaths per 1000 live births, compared to 110 for all Africa but 13 for Europe. Life expectancy for a child born today is about 58 years compared to India's life expectancy of 54.

If we can give our population assurance of infant survival, this way we can boost the achievements of our family planning services. We are totally committed to continued improvement of health services to further reduce infant mortality and to build the confidence in married couples to have small families.

POPULATION POLICY IN THE OFFING

For years now there has been a series of seminars, workshops, conference and research studies aimed at building up a consensus for the need and desirability of a population policy for Zimbabwe. The latest of these was a series of regional and national workshops organised for parliamentarians by the Zimbabwe Parliament in consultation with the Ministry of Health and the Zimbabwer National Family Planning Council. These workshops which attracted 370 participants from parliament, government, non-governmental organisations, political parties and the private sector clinched the consensus by calling upon government 'to develop a comprehensive national population policy' and to take steps to implement that policy, involving all levels of the country's leadership in population and development planning, including educating all the citizens about the relationship between population growth and economic development and changing attitudes towards the status of women, family size and family planning.

Because of the succesful achievement of a national consensus, the Ministry of Health with the approval of the Head of State, President Mugabe, has initiated a research unit to work out the modalities of co-ordinating the formulation of a national population policy. A three-tiered structure is envisaged. At the highest level will be the National Population Council (NPC) which will comprise representatives of Cabinet, the Zimbawean Group of Parliamentarians on Population and Development, the Private Sector and non-governmental organisations. It is hoped that the NPC will be chaired by the President of State. The NPC is to have overall responsibility for policy direction.

The second tier is going to be a Secretariat for Population Policy. The Secretariat will consist of professional and technical staff and its responsibility will be to initiate and oversee the implementation of the National Population Policy and it will be the Executive arm of the National Population Council. The proposal suggests that the third tier will be called the National Consultative and

Co-ordinating Group which will consist of representatives of relevant government departments, NGOs and the Private Sector. This tier will work 'hand-in-hand with implementing agencies. These proposals have been put to government and they are under active consideration.

THE FOOD AND ENVIRONMENTAL SIDE OF THE EQUATION

Zimbabwe is rich in natural resources - agricultural, mineral and hydrological. Again, at independence the Zimbabwean government designated the agricultural sector of the economy as a top priority area. Indeed impressive achievements have been recorded in this sector. Zimbabwe has been able to produce a surplus for export of its agricultural products, except in drought years and these have been too frequent in recent years. However, even in drought years, Zimbabwe has been able to feed itself.

Due to a colonial legacy, more than 70 per cent of the population lives in communal lands, which are of marginal agricultural value. However, the surprising thing is that over the past few years, more than half of the national staple food produce has come from the communal lands -- thanks to the government's agricultural and technical inputs which have gone to communal farmers.

ENVIRONMENTAL DEGRADATION

Although Zimbabwe has been able to produce surplus food, her ability to sustain this development will be largely dependent upon two major factors, namely, a successful implementation of a population policy which will assist the country to reduce the population growth rate and secondly, an effective conservation strategy that will prevent further deterioration of the land. As already indicated above, 75 per cent of the population live in the communal areas which are characterised by comparatively high population density, low and erratic rainfall and periodic droughts. As a result the land has been over-used, wood supplies and vegetative cover are near exhaustion and other natural resources have been severely degraded.

Experts say that soil loss in the communal lands is estimated between 50 and 100 tons per hectare per year. Dr. Chris Magadza of the University of Zimbabwe, suggests that this large loss of soil places Zimbabwe among the top 20 of the 62 countries surveyed by the World Bank for sediment transport. He says that the principal factors causing such high losses are inappropriate livestock management and poor cropping technology. This soil loss threatens the future viability of the country's agriculture. Soil losses also affect water resources. The country is experiencing an unacceptably high level of siltation of rivers, dams, lakes and other natural water reservoirs. Magadza warns his fellow Zimbabweans: 'undoubtedly water will be the ultimate limiting factor in Zimbabwe and our ability to manage it correctly will be crucial to our development. There must be an upper population limit beyond which our water resources would no longer cope'. He further says that indications are that by the year 2030 Zimbabwe's water resources would have reached their limit.

PROJECTS AND PROGRAMMES FOR RESTORATION AND CONSERVATION

There is a growing national awareness about the importance of the environment. Government has taken deliberate measures to arrest the deterioration of our natural resources and preserve and enhance those resources that are still in their pristine state. It has launched a pilot Rural Afforestation Project under the Forestry Commission. The objective of the project is to encourage farmers, local government authorities, schools and rural communities to establish woodlots. Fifty-four plant nurseries have been established in the districts and urban areas. A national tree planting day which falls on the first Saturday of

December was declared from the year of independence, 1980. The political leadership of the country takes the lead in the events of the tree planting day. A special message from the President of the State is read at the official Ceremony of the tree planting day.

The Department of Natural Resources has a statutory mandate to promote the adoption of objectives on standards relating to (1) sustaining environmental quality and pollution control (2) mitigating adverse environmental impacts likely to be caused by new developmentprojects, and (3) providing Zimbabweans with information on environmental issues. The Department's programmes and activities aim at fostering harmony between society and the environment for the benefit of the present generation and posterity.

The Department of Natural Resources has in place programmes for grassroots involvement and support. These programmes include organisation of consultations, briefings, workshops and seminars to consider environmental issues specific to each geographical area of the country. The consumers of these activities are the decision makers, politcal and traditional leaders, land users, women, the youth and students in school and colleges. Another strategy has been to use field days in the rural areas for practical demonstrations of sound natural resource management and rehabilitation. Rural communities have been involved in gulley reclamation, construction of contour ridges and establishing woodlots. Government is also encouraging more use of solar energy, biogas and wind energy. Regulations have been made to protect river banks and to illegalise unplanned land use for building residential housing and agricultural cultivation.

CONCLUSION

Whatever it is that we do each as an individual country, the problems associated with the environment are long term and must forever be uppermost in the minds of world leaders. Some of these problems will readily be addressed with some hope of success by individual national governments and yet other environmental problems do and will require inter-governmental actions and co-operation. For example, the problems of air and water pollution, the siltation of international water sources, and the creeping of desert conditions across national boundaries, can only be addressed with any hope of success on an international basis.

The food-population equation is inseparable from the protection and preservation of the environment and also relates intricably to the question of national security. The latter can only be ensured by the satisfaction of national desirables such as full employment and provision of food, health, education and shelter for all. And these national desirables are no less basic human rights than justice, freedom of expression, association, and conscience and the right to life itself.

Mr. SCHEUER. Thank you very much, Minister Kwidini.

Congresswoman Schneider, any questions?

Ms. SCHNEIDER. No. I would like to hear Mr. Sotomarino's testimony.

Mr. SCHEUER. Congressman Smith, any questions?

Mr. SMITH. No, sir.

Mr. SCHEUER. All right. We will move along to Celso Sotomarino, a Member of the House of Representatives in Cuba, Secretary-General of the Inter-American—

Mr. SOTOMARINO. In Peru.

Mr. SCHEUER. Peru. What did I say? Oh, my God. As Fiorello LaGuardia used to say, "When I make a mistake it's a beaut." I apologize.

He is a Member of the Parliament of Peru. He is Secretary- General of the Inter-American Parliamentary Group on Population and Development. So here today we are honored by having three Secretaries-General of continental parliamentary groups: Sat Pau Mittal, Secretary-General of the Asian Parliamentary Group; Minister Kwidini, Secretary- General of the African Parliamentary Group; and now Celso Sotomarino, Secretary-General of the Inter-American Parliamentary Group.

We are honored and delighted to have you here today, Mr. Sotomarino. Please take your five or 10 minutes and then we'll have some questions for you. And, of course, your prepared remarks will be printed in full in the record.

STATEMENT OF CELSO SOTOMARINO, SENATOR PERU

Mr. SOTOMARINO. Thank you very much. I learned from conferences where I assist, that in more than 20,000 years, maybe 40, maybe 60, who knows, we will reach 100 billion people in this planet; and that in 150 more years, we will be nearing 50 billion. The possibilities are, according to some opinions, to be 8 billion by 2050, but according to my calculations and information I have on how quick is coming now another billion, it should be something like maybe 15 years for another billion, 12 for the next, eight for the next, six for the other one, five, four, two, one. So in 38 years we might be 15 billion.

This is a mathematical probability. Our fight is for this not to happen, but this is a mathematical probability. And if this happens, we are through—the whole world, with my native Peru and the beautiful USA included. If these things happen, and they are already happening, we go for more poverty, more malnutrition, more problems with poor health, more and more illiteracy and, specifically in my country, problems of utilization of natural resources, tremendous cocaine production, tremendous problem of terrorism costing—up to this moment—15,000 people killed and $2.0 billion per year.

This is generating migration problems, very serious migration problems from the country to the cities. Peru was 40 percent rural 40 years ago and now is 70 percent urban. This made tremendous congestions in the cities and this problem of migration that grew Lima since 1940. Like my father said, when I was a kid in 1940, we are already very important in Lima. Lima City is more than

500,000 people, he said. And that was 1940. Forty-eight years later, we are 7 million people. Fourteen Limas occurred during this short period.

Mr. SCHEUER. Mr. Sotomarino, when I was a college kid, I was a summer intern at the Banco Nationale de Credito Rural in Mexico. That was 1939. And the population of Mexico at that time was 18 million.

Here, just exactly 50 years later, it has gone from 18 million to 75 million. It has gone up approximately four times in half a century.

Mr. SOTOMARINO. It looks like we had to take care of these kinds of problems a long time ago. Nevertheless, we have now the experience and we have the problem. And the projection? We are not acting with enough intelligence and with enough determination to stop this.

I said in my country several times that we don't act rationally, intelligently, with instruction, with education. Intensively, right now, we are going to have to enforce in the very near future like they had to do in China, going to one family, one son.

Since 1820, Peru increased its population .7 percent; moving in the economical development, a very poor one, but feeding the needs of the population. Since 1960 to now, we had a gross national product net, discounting the population increase, of 1.08 percent. This means 24.6 percent in 27 years.

In the same period the population grew 150 percent. This explains everything. This explains all the problems. My friend Garcia in Peru explains a very important part of the rest of the problems, but this is not as important as our previous non-caring of these kinds of situations before.

Nevertheless, Peru is a very rich country. They say that Peru has the most rich ocean in this planet. We are very important copper producers and silver producers and we are discovering plenty of gas, plenty of oil and things like this.

Our capacity for industrialization is very poor. It is so poor that we used to find the USA, Russia, somebody, being guilty of our problems, but not ourselves because we should be too much worried about ourselves if we should speak clearly between us. But I never had any inconvenience to speak clearly.

That is why Senator Durenberger at this moment used a very polite and delicate sentence. He told me, "How is Peru going to survive?" I said, "We did for so many years since the Incas, that we will. We will." Anyway, we'll keep going and moving in terms of some bad dream that we'll be separated.

Mr. SCHEUER. Well, the Incas had a certain type of population control by throwing people off the pyramids and cutting their hearts out and so forth.

Mr. SOTOMARINO. Yes, but look at this. There were close to 15 million, according to the historical information we have, but I think it's an exaggeration. But they were involved with part of Colombia, all Ecuador, all of Peru, part of Chile, and part of northwest Argentina.

They had an economy of survival and they fed the people. Their culture was their religion and they produced enough to feed their people.

But now in Peru, it is a matter of production. This is what we don't want to believe and there are certain obsolete Communist politicians in Peru that say that if Peru has good economical development, their revolution is going to be delayed. When you have these kinds of people inside your own country, you are really in danger if you don't fight them—which nobody has decided to do up till now.

We have a very difficult geography, and transport and communications are very difficult. The environment is very conflicting, because we have tremendous mountains from the tremendous rivers to the east part, and to the west a long, dry desert, which is a very important part of the copper and iron industry and everything.

We have to realize—and I do—that countries reach development where countries have a good population policy. And we have to have one. But problems in Latin America, problems not as bad as the Peruvians, but problems anyway, happen in Chile and Argentina and Uruguay, even in Brazil, in Bolivia and Colombia, El Salvador and Nicaragua, most of these countries having good control on their population growth.

Anyway, we sometimes think we talk too much about some items. For instance, we are talking about the need we have particularly for children. Who is opposed to this idea? Nobody is opposed. Everybody agrees with this idea anyplace, any political system, any color of people, but actions are not sufficiently good in the whole world.

That is why I am very militant of IPPF, especially in the western hemisphere region. We are acting. We are not talking too much; we are doing things all over America and all over the world. Governments have more political problems to establish solutions. That I know because I am a politician myself. That's why I feel like the private sector, NGOs must be heartily supported, and through them we can take care of children, we can take care of the women's rights and everything.

This is my general point of view and I don't want to take more time because we can talk later a little bit.

Mr. SCHEUER. Thank you very much, Celso Sotomarino.

Now we will hear from Mr. Robert Key, Member of the British Parliament, who is Parliamentary Private Secretary to the Minister for Overseas Development. He is also Secretary to the Parliamentary Group on Population and Development in England and he is Vice Chairman of the Parliamentary Group on AIDS. He is an Executive Member of the British Branch of the Interparliamentary Union.

We are delighted to have you, Robert Key. Please take five or 10 minutes or whatever you may need, and then we'll have questions for you and the whole panel.

STATEMENT OF ROBERT KEY, MEMBER OF PARLIAMENT HOUSE OF COMMONS, ENGLAND

Mr. KEY. Thank you very much, Congressman. I'll try and beat the amplification system. I have a loud voice so I could turn it off if it would actually be less annoying.

Could I first of thank you, Congressman Scheuer, very much indeed for your hospitality and thank your staff for their administrative arrangements. It is no small feat to bring parliamentarians from each of the continents of the world to Capitol Hill and I congratulate them.

Mr. SCHEUER. Let me, while you are congratulating staff, let me add my word to that. Lisa Jordan here and Dr. Eileen Lee, Michael Rodemeyer, they all worked very hard over many, many, many months to prepare this set of hearings, working in close collaboration with Cecile and Pudy and Akio. I can't tell you how many hundreds of hours of effort were put into organizing these hearings, and I want to express my thanks not only to the Global Committee of Parliamentarians on Population staff, but also to our congressional staff for their wonderful work and labors.

Mr. KEY. Thank you, Congressman.

Mr. MITTAL. Certainly they do deserve it.

Mr. KEY. It is particularly auspicious that we have this hearing today which is the 200th anniversary of the Congress. We take a long view of these things in the United Kingdom. The first Member of Parliament from my constituency was elected in the year 1275, some 714 years ago, so you're doing quite well; keep it up.

[Laughter.]

Of course, Congressman, politics is the art of the possible and politicians are supposed to find solutions. And I have to say that the world's politicians have not been doing very well when it comes to population and development.

Mr. SCHEUER. I would say that they may not be doing very well, but they're doing a hell of a lot better than chiefs of state and executive branch governments all over the world. It's mostly the parliamentarians that are pushing the executive branch governments.

In the last eight years in this country, for example, every year the Reagan Administration came along with vastly reduced funding proposals for population and family planning. But the Congress stood firm and resisted those cuts.

It's the United States Congress that has gotten our government into the business of counseling and helping countries abroad, and this was true over the past generation through Republican as well as Democratic administrations. The Democratic chiefs of state were no more or no less enlightened than the Republican chiefs of state and it's been a bipartisan, bicameral coalition on Capitol Hill led by people like Claudine Schneider and Silvio Conte, and I can't tell you how many others of the Republican Party, along with their Democratic colleagues, as well as senators from both parties in the other body—as we call it—it's that collection of convinced people from all points in the political spectrum except the two extremes, left and right, that have kept our population programs alive and that have fueled progress.

And it is the Congress of the United States that made us a leader in the first place and that fought a moderately successful rear guard action over the last eight years when the past administration just terminated, wanted to pull us completely out of the field of family planning, with vast reductions that they wished to make not only in our foreign programs but in our domestic programs as well.

Would you like to add anything to that?

Ms. SCHNEIDER. I would be delighted to hear Mr. Key complete his remarks and then I will—

Mr. SCHEUER. You don't want to take any credit for having been a leading member of this bipartisan—

Ms. SCHNEIDER. You have given me more credit than I could possibly humbly accept, so I will accept your congratulatory remarks.

Mr. SCHEUER. Okay. But I think that the Global—

Mr. MITTAL. By not adding anything to what you have said, she approves of what you have said.

Ms. SCHNEIDER. Exactly.

Mr. SCHEUER. I think the Global Committee of Parliamentarians on Population and Development have mobilized, enlightened, thoughtful leaders of parliaments around the world. That's been our business. That's what we have been doing for over a decade.

To the extent there has been progress, to the extent that Executive Branch leadership has been brought into the population field, to the extent that we have convinced chiefs of state, health ministers and finance ministers, that this is absolutely necessary, I think members of parliaments can take a great deal of credit around the world.

I yield back to you, Mr. Key, and I'm sorry to interrupt. I couldn't resist that one.

Mr. KEY. That was a harsh judgment and I must resist the temptation to make comments about the internal politics of another country.

Mr. SCHEUER. We have done nowhere nearly as well as we should. You are quite right there.

Mr. KEY. I believe one reason that we haven't done very well is that until now there have been very few votes on other people's problems. That is something which we have to recognize in a democracy.

I am being beaten by your technology, Congressman. Can we put it on the floor or somewhere?

Mr. SCHEUER. Well, let's try it the way it is.

Mr. KEY. Or closer. Is it better closer?

Mr. SCHEUER. No, no.

Mr. KEY. It's not better closer.

Mr. SCHEUER. Just point it to the side and maybe it won't pick up so much. Great.

Mr. KEY. So there are few votes on other people's problems. But I think there is now a completely new mood about and there is a very simple reason for this. I think perhaps population issues were seen, maybe 20 years ago, as a vehicle for cranks or visionaries. Perhaps the cranks were visionaries. But it appeared that people who had these particular views were not taken seriously, to say the least.

Then we entered a new phase, a phase of the experts, and the experts have been telling us for 20 years or more, exactly what we could expect to come about. Still the politicians took no notice.

Then we went through a phase of what could be described as paralysis by analysis, when there was a great deal going on, but the politicians somehow froze. We went through a phase of being ready to respond very positively to disasters around the world, but ignoring the everyday crisis. And, of course, in so many developing countries, every day is a crisis.

Prevention is better than cure, though. And now we find that a green approach to our problems actually saves resources. So many of the problems concentrate on children in developing countries that I would like to start actually with a reference to my own children. It is not unknown for their politician father to be subjected before school, at breakfast, to quizzing on the ozone layer, on whales, on acid rain, on tropical rainforests, and I'm sure we can all share that experience, thanks to the teachers doing a good job on that.

But the challenge is not just for us to loosen up and to react positively, but to encourage the developing world to join us in tackling the global issues. This is a very big problem because we have got to convince the developing countries that we are putting our own house in order. This is, if you like, the old greenhouse effect: People in glass houses shouldn't throw stones.

There is, of course, a great paradox to development, that in order to stabilize population we need to spend more on child health and welfare. If we provide mothers with literacy, with education, with employment, with child health, then we provide alternatives to a growing number of births.

Politicians I think have given a poor lead on family planning in the past, and I would simply ask my fellow Christians in America to examine their consciences when it comes to cutting off funds to the IBPF or the United Nations agency, the UNFPA.

I believe there is a lot of confusing signals coming out of this and it is very hard for those of us in the rest of the world—and I speak as not only a practicing Christian, but as someone whose politics is right of center—it is very hard for us to understand where the morality lies when you consider that 40,000 children are dying every day, but the United States is cutting off the funds which could prevent such a large tragedy in the first place.

Another factor which I draw attention to in my submission is the problem of AIDS, and I do think we need to be far more realistic about AIDS in the world. This is not a comment aimed at the developing world alone. I recently met the foreign minister of an Asian country a month ago, who tried to convince me that there was no case of AIDS in his country, nor would there be because of their particular culture and religious system.

I also have to say that at the end of last year I was in Canada where I was dismayed, to say the least, to discover that there are still some provinces where it is forbidden to give AIDS education in secondary schools.

Now, we therefore need far more realism. After all, if the USSR is now predicting 200,000 deaths from AIDS in the Soviet Union by the end of the century, then surely we can all be better served by more realism.

Mr. **Scheuer**. In the United States, I can tell you in New York City, it has been proposed by our Health Commissioner, Steven Joseph, a very brilliant man, to provide fresh needles to drug addicts. And that has been turned down by the authorities that be in New York because it would be deemed as permissive and encouraging drug use, if you can imagine a greater idiocy than that.

Sectors of our population want to refuse to give condoms to homosexuals because they say it will encourage promiscuity, if one can imagine a more death-dealing policy than denying condoms to homosexuals who are engaging in practices that rampantly spread the AIDS virus.

Mr. **Key**. I can, Congressman, imagine a greater idiocy in the refusal of a number of nations, including my own, to take the problem of AIDS in prisons seriously. And that is something which we ignore at our peril.

Mr. **Scheuer**. Well, we don't. We do not do that, nor do we take the problem of AIDS in the military seriously. When an AIDS-afflicted serviceman is released from the service, there is no way that his spouse or his live-in lover will be informed of the fact that he has AIDS, even though the military knows about it, unless he voluntarily tells them.

And the same thing with prisoners here. We have no government program of informing spouses or live-in companions that the person who is coming out of the military or coming out of a prison is afflicted with a death-dealing sickness which they can readily pass on. Absolutely aberrational.

Mr. **Key**. This is clearly another area which we should address at a future date. But as far as this hearing is concerned, I believe that one of the important things we should consider is the impact of the AIDS pandemic among children and young people in developing countries.

The effect is not just going to be a primary effect of health care in communities which are already starved of resources for health care. It is going to be the secondary effect of the impact on the employment of young people and the activity of young people when AIDS has effectively wiped out such a high proportion of the economically productive section of the population. And this, of course, can lead to considerable exploitation of children.

If I may turn briefly to deforestation, there are short- term gains in deforestation, but one of the most serious aspects here is the loss of species, and genetic diversity is absolutely crucial to this planet's future. After all, you look at the rainforests, and you see that 40 percent of all the drugs in the United States are based on chemicals derived from rainforest species. It is estimated there are 2,000 rainforest plants with the potential to fight cancer.

And I congratulate Congressman Scheuer on his new bill which he introduced yesterday in the House on national biological diversity. And I wish that a fair wind.

Mr. **Scheuer**. Thank you. One hundred and four members joined me, and it has been introduced on the Senate side by Senator Al Gore. One hundred and seven now, I hear.

Mr. **Key**. Good. It puts it into perspective, Congressman, when you consider that 98 percent of the species which have been on this planet since the world began are now extinct, and we are exterminating two species a day.

Mr. **Mittal**. Two species a day?

Mr. **Key**. Two species a day. It's not just, of course, tropical forests. We look at the Horn of Africa, and what a tragedy we see there, a symbol of the failure of every sort of development politically and economically. We see there, of course, not tropical rainforests but different sorts of woodlands which are being destroyed because of the cycle of poverty which was referred to by Mr. Halliday earlier.

This leads me on to the point about a necessity for a new world scientific base. We need the right sort of perceptions. This is what politicians should be looking for in seeking solutions. We need perhaps to look at the need for research in forestry. After all, there are millions and millions of dollars spent on research into superior kinds of cereals to add to the grain surpluses of Europe and North America. How much money is spent on genetic engineering of trees to be more suitable for the climates and the conditions which we face, for instance, in sub- Saharan Africa?

Going with a new world scientific base we need, of course, to introduce good economics. That starts with the debt problem. The debt problem is not insoluble. In the United Kingdom, we have now written off $2.0 billion worth of debt in 22 developing countries. That is a drop in the ocean, but it is a start in coming down.

Mr. SCHEUER. What percentage reduction is that?

Mr. KEY. I couldn't give you the figure off the top of my head.

Mr. SCHEUER. Is it a 50 percent?

Mr. KEY. I couldn't give you the figure at this moment, Congressman.

I think, however, when we look at that, we have to be a little bit careful. There are two great risks involved with handling debt. We don't want just to transfer the problem from commercial banks to taxpayers, nor do we want to deter the banks from investing in those countries again.

Too many of the proposals that have been made so far, that has been the effect. Banks don't want to lend to the developing countries. That is bad for every reason. One of the most important things is to ensure that there are market mechanisms introduced which are appropriate to developing countries. One of the tragedies that we have seen around the world time and time again is political dogmas compounding the situation they set out to solve, because they refuse to acknowledge that farmers are human beings and no one is going to grow anything for nothing.

The fact that market systems are broken down inside so many countries, in Africa and elsewhere, is a needless tragedy. It takes political courage to actually reintroduce realistic market systems and pricing, but it must be done. After all, we have to realize that trade has a much bigger impact on developing countries than aid ever can have or indeed ever should have. The ratio, I understand, is about 3:1 in terms of foreign currency in favor of trade.

Now, I believe that we face a great opportunity in the world now because we are facing a new diplomacy. For 40 years the nations of the world have been busy—I won't say "obsessed"—with nuclear weapons, with disarmament. We now face a new era where I believe that trade and environment are going to be the language of diplomacy, and diplomacy is going to concentrate on that more and more and more in the coming decades.

This in turn will raise problems of sovereignty. It was, after all, the president of Brazil who said recently, no foreign money can buy a single square meter of Brazilian Amazon soil. True. And we cannot go around the world as if we were neo-colonialists, telling people how to solve their problems. Britain understands that.

I draw attention here to the role of the non-government organizations. They are very often the best organizations to get to the heart of the problem. Where governments fail, NGOs can reach parts of the community and society where politicians fear to tread, and non-government organizations are very remarkable. They need every bit of help they can get.

The political response in my country and the United Kingdom has recently been an increase of 40 percent in funding of our NGOs. That is very significant indeed. And it's time that politicians and bureaucrats recognize that there is a whole world of idealism in the NGOs that can be used to the enormous benefit of the recipients. It gives rise to new problems of management of the NGOs themselves, but those again can be solved by politicians with the right will.

Finally, could I draw attention to the problem of institutions? Politicians, being very fond of talking to themselves, tend to create more committees, more institutions, which they perceive will solve problems. They won't. There is no time, in fact, for us to create new castles in the air. What we've got to do if we are being realistic politicians is to use what we have.

Take the United Nations. If it didn't exist we would have to invent it. So why try and invent it twice over? The United Nations' institutions cover environment, social issues, refugees, agriculture, and so on. We should use them. We should support them. We should adapt them to help solve the problems of the world.

I would also draw attention to the role of the World Bank. It is often criticized as being environmentally insensitive. I think there may be about six cases where the World Bank has made mistakes which are easily identifiable. But now it is true that in more than 1,000 cases that they are clearly the leader in environmental research and poly- initiatives amongst those, and that is something we should not underestimate.

If I could end on a legendary note with reference to the classical European legend of Pandora's box. A beautiful box was given by Pandora to Jupiter and when the lid was lifted, evil and disease escaped across the world, afflicting the whole human race, and only hope remained in the box. Well, Congressman, we don't want hope to remain inside that box any longer.

The job for politicians in the next few years is to get hope to fly. We shall, of course, save our earth because there is no option.

Thank you.

[The prepared statement of Mr. Key follows.]

WORLD POPULATION GROWTH AND ENVIRONMENTAL DEGRADATION: A BRITISH PERSPECTIVE

(Evidence given by Mr Robert Key, Member of Parliament for Salisbury, to the Sub-committee on Natural Resources, Agriculture Research and Environment of the Committee on Science, Space and Technology on Thursday, 2 March 1989 in the Rayburn House Office Building, Washington, D.C.)

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INTRODUCTION

When told what "every schoolboy knows", Groucho Marx replied, "Go outside and get me a schoolboy".

It is obvious from my own domestic breakfast table that schoolgirls are at least as well-informed as schoolboys. My youngest, 9 year-old daughter has been known to lecture me before departing for school on the ozone layer, acid rain and the destruction of tropical rainforest. I say nothing of whales! You would have to be a pretty bull-headed father, or an extremely obtuse politician, not to recognise that the world has turned. Environmental issues are no longer confined to the bottom of the inside pages of serious newspapers. Instead they are front page news and prime-time television.

So environmental issues are moving fast up the political agenda. Unfortunately that movement owes little to discerning long-sighted argument. But I start by paying tribute to the clear-sighted leadership of Britain's Overseas Development Minister, Mr Chris Patten MP.

THE SCOPE AND NATURE OF THE PROBLEM

When Prime Minister Brundtland launched "Our Common Future" in the Queen Elizabeth II Conference Centre in London in April 1987, she knew that a London launch would maximise worldwide publicity. She even made sure she had those essential modern marketing tools - an excellent video and a couple of TV series. However, the World Commission's report did not really capture popular imagination and concern. As far as I am aware, "Our Common Future" never entered any bestseller list. It certainly failed to find a Bob Geldof to give it massive public appeal - though, to be fair to Sir Bob, he did appear in one of the television series.

The Report itself recorded that during the 900 days the World Commission was at work:-

(i) the African drought put 35 million people at risk and may have killed a million;
(ii) the Bhopal accident killed 2,000 and injured 200,000 more;
(iii) the Chernobyl reactor explosion caused

damage across Europe;
(iv) a chemical fire in Switzerland poisoned the Rhine all the way to the Netherlands;
and least heralded and most shocking of all -
(v) 60 million people (more than the population of Britain) died of diarrhoeal diseases caused by malnutrition and dirty water.

Since then we have had floods in Bangladesh and Sudan, hurricane "Gilbert" and the earthquake in Armenia. In all four cases, man's failure to respect his environment (by deforestation, by ripping out mangroves and hence coastal defences and by failing to enforce building codes) added to the scale of destruction. It seems that we still find it hard to give serious attention to the problems until we are forced to do so.

But the case is not hopeless. Environmental issues are coming sharply into political focus. I should like to start by drawing two distinctions.

The first is the obvious one that environmental problems not only have different impacts in developed and developing countries, but solutions in the two pose different degrees of difficulty. In saying this, I am not minimising the domestic environmental challenges and (let us not forget) opportunities we face in Britain. Ensuring that our future development takes careful account of the environment, and that it is based on sustainable growth, will involve dislocations and economic trade-offs. It will need imagination to make full use of the new possibilities available to us. But we are a rich country, with good soils, a temperate climate, educated, healthy and well-fed people, a long scientific tradition and democratic institutions. We face the problems of affluence and have the resources to determine the quality of growth. In Britain we have the luxury of choices and probably both the time and the resilient resource base to be able to afford some mistakes. We exercise those choices in an atmosphere of vigorous debate.

Poor countries have to deal with problems posed by fragile ecologies and uncertain weather against a background of poverty, rapidly expanding populations, lack of qualified manpower and a limited scientific base. While they face exceptionally difficult choices, many countries do not have the democratic institutions needed to develop a consensus which all can respect. That said, developing countries perhaps stand to gain even more than we do from responsible use of the environment. Experience has taught us that prevention is cheaper than cure. If one addresses environmental concerns early enough in the project cycle, a "green" approach may actually save money.

My second distinction is between two classes of environmental problems - the global and the local. Global problems are those that inevitably affect the whole of mankind and can only be solved if all the world's nations collaborate. Local problems are to some extent "location-specific" and are amenable to national or regional action.

The distinction is not always clear-cut and may depend on the scale as well as the nature of the activity. So, for example, widespread deforestation is global to the extent that it destroys species and increases carbon dioxide, but also local in its effects on soil erosion. I would characterise depletion of stratospheric ozone, the build-up of greenhouse gases, climate change, loss of genetic diversity and the loss of major irreplaceable natural assets as global problems.

Local problems of principal concern to developed countries are largely caused by industrialisation and affluence. They include the pollution of air, water and soil which may be very widespread but are still capable of solution by the North alone. Developing countries face a long litany of local resource degradation problems including deforestation, desertification, soil erosion and salinisation. They suffer industrial pollution and the effects of rapid urbanisation, unclean water and inadequate sewerage disposal.

I consider that one of the most difficult international environment issues we will face over the coming years will be to engage the developing world in the drive to tackle global issues; this will certainly involve helping them tackle what they see as their own priority environmental difficulties which may not currently pose any global threat.

In focussing on the international dimension I draw attention to an excellent lecture by Sir Sonny Ramphal. He sketched out the scale of degradation through deforestation, desertification and pollution of soil, water and air. He graphically demonstrated what he called: "The simple, and terrible, truth...that poverty and environment are inextricably interlinked in a chain of cause and effect."

He stressed the role of population pressures. He touched on the implications of possible climate change. He looked at the emerging international response to environmental issues and suggested some tools that decision-makers needed. He raised the problem of national sovereignty. But he stopped when the argument got interesting!

The Pressures of Population

Sir Sonny made the population issue more immediate by quoting statistics from just two countries. We need to look at the overall picture as well. The Brundtland Report cites United Nations figures which suggest that world population will stabilise at something between eight and 14 billion or 60% to nearly 200% above today's level.

The range in these projections is enormous. It is as large as that precisely because we have the chance to influence the outcome. At the bottom end of the range, we could increase food consumption per head through foreseeable improvements in agriculture and keep present food habits: at the top end, we could not - there would have to be massive changes in diet and in our use of the environment.

It is one of the most important paradoxes of development that in order to ensure that population growth stabilises near the bottom end of the projected range we need to improve children's chances of survival. Provide mothers with literacy, education, employment opportunities and child health programmes and you provide alternatives to many births as a way of ensuring security in old age.

For a wide variety of reasons, politicians are not giving leadership on family planning issues. Recently Indian politicians told a group of visiting British MPs that "we don't discuss this at election times". I fear it may be true that politicians cannot win elections by saying they will improve living conditions in poor countries - they must promise to let the poor hang on to the squalor they have, but which they can at least afford.

We all need to realise that female children are as important as male children. More men should be involved in running family planning associations (FPAs) and clinics both in the developed and the developing worlds. This can and does happen - I have seen the enormous success of family planning programmes in West Africa.

We need to ask ourselves why the sterilisation of women is up and contraception is up, but the vasectomy rate is dropping steadily. There are many religious and cultural barriers to be overcome - but there is plenty of evidence that with modest resources and good sense these barriers can be successfully overcome.

Liberal westerners have to learn to be sensitive about these issues and just as well-meaning western politicians tend to parachute in to developing countries full of good ideas, too often family planning associations sponsored by the International Planned Parenthood Federation (IPPF) are perceived as parachuting in condoms. We know this is far from the truth. I have for myself seen family planning associations in developing countries which can reach far further into society than most indigenous governments appear to be able to do. FPAs are involved not only in very basic community development and women's issues, they are involved in much more sophisticated problems such as parasite control, literacy and even banking. Once they have gained credibility, they have shown the local communities that they, the local mothers and fathers, have the power to change the future.

There is, indeed, a danger that the more sophisticated and democratic a developing country, the greater the inertia. It was an Indian politician who recently described that country's population problems as paralysis by analysis.

The Implications of the AIDS Pandemic

It was only a very few years ago that many of the countries in Africa worst affected by AIDS denied that a single case existed within their frontiers. Most of those same countries should now be congratulated on their realism and responsibility in facing up to the problem of AIDS. However, not all countries do. I was recently shocked to hear the Foreign Minister of a developing Asian country say to me that, because of their superior religious and cultural traditions, there was no recorded case of AIDS in their country and that they were sure they would escape the disease. And all my life I had been brought up to believe that the ostrich did not live in that part of the world.

In that country, as in Britain, governments must react - swiftly and in unison.

I can think of no area of public policy in respect of which any government has reordered its priorities as swiftly as has the British Government in the face of AIDS. There is a long way to go, but the Government has provided finance swiftly and set in train a remarkable amount of research.

I have recently visited the poorest parts of Africa, as well as Latin America and Canada - always in connection with development, family planning or AIDS. I have reached two conclusions. The first is that the British Government is handling the problem better than any other government, particularly in helping people to cope with AIDS and in the effectiveness of their public education programme. Money has always been available. The problem has usually been a lack of people to use it. As our ability to use that money improves, more money must be forthcoming and I have no doubt that it will be made available.

Secondly, neither the United Kingdom nor any other country can afford to be xenophobic. AIDS is a pandemic problem. Its significance cannot be overstated. Politicians tend to hyperbole, but the danger on this occasion is that politicans throughout the world will not speak out. That danger is relevant to closed political systems, such as those in the Soviet Union and in China, where there have recently been unpleasant manifestations of xenophobia over overseas students.

The danger is not limited to developing countries with fragile democratic or other systems. It is a feature of the most sophisticated democracies, such as Canada. On a recent visit I was shocked to discover that there are still states in Canada that do not allow AIDS education to be provided in their schools. As a nation that still operates a comparatively open door immigration policy, Canada must face up to the prejudices about immigrants and all foreigners, because of the heightened fear of AIDS. However, it would be an error in Canada, in the United Kingdom or anywhere else to single out immigrants or overseas students. Statistically, their impact is vastly smaller than that of the millions of people who flood into and out of our airports, whether on business or on holiday. Can anyone seriously suggest that in current circumstances every one of those international travellers should be AIDS tested, with all the attendant problems, including the insurance implications?

The pandemic is in its early stages and no one is certain of the number of AIDS cases. The World Health Organisation estimates that there are more than 250,000 AIDS cases, but between five million and ten million people worldwide are probably infected by the virus. Within the next five years, about one million new AIDS cases can be expected. The global situation will become much worse before it can be brought under control.

Poverty is probably the most important co-factor influencing the spread of the AIDS virus. Africa in particular has been afflicted simultaneously by HIV infection and unprecedented economic deterioration. With per capita income lower than in 1980, and a fall of 4% since 1986, the continent's debt is now three times greater than its export earnings, with no effective relief in sight. The falling prices for African exports have cost African countries nearly $50 billion since 1986.

According to leading British epidemiologists, between 11% and 20% of the general population of countries such as Kenya, Tanzania, Zambia, Angola and Somalia are HIV positive. Uganda has the highest reported HIV seroprevalence in Africa, reaching 80% in high risk groups, including prostitutes, blood recipients, patients with sexually transmitted diseases, the visitors of prostitutes and partners of any of the above. Between 61% and 90% of such people are HIV positive in Zaire, Uganda, Kenya, Ruanda and Burundi.

The computer modelling carried out by Professor Roy Anderson of Imperial College, London and his colleagues suggests that under certain conditions, over a period of decades, AIDS has greater potential to depress population growth rates in developing countries, especially in sub-Saharan Africa and South America, than smallpox and bubonic plague in the past.

Therefore, the AIDS pandemic will mean that, even more than in the United Kingdom, there will be a huge reduction in the number of young economically productive men and women. That will have considerable economic and social effects on societies that already suffer mass poverty and death from hunger or from simple diseases related to undernourishment. In addition, the present period between infection and the development of AIDS - thought to be eight to nine years - will be reduced in developing countries where people are exposed more frequently to, and to a larger range of, infectious agents than are those in the developed world.

Experts argue that the focus on the number of AIDS cases rather than on the entire spectrum of HIV infection has distorted our understanding of the size of the epidemic. The collection of accurate data has been hindered by political and social sensitivites in developing countries, as well as by under-recognition, under-diagnosis and under-reporting. Experts say that, although AIDS is unlikely to affect the ratio of dependants to non-dependants in such societies, the high predicted mortality of AIDS, which requires repeated hospitalisation, perhaps over a period of years, and which is thought to enhance morbidity due to other infections such as TB, will be devastating to already overloaded health care systems in poor countries.

It is impossible to imagine how such health care systems will cope. There is no vaccine in sight and the only hope for arresting the further spread of HIV is the development and forceful application of education programmes that are aimed at changing behaviour. So what are we doing about that in Britain? We are supporting a programme of research into the socio-economic aspects of AIDS. One study will investigate the future demographic and economic impact of the disease. Three others will contribute to a better understanding of the social contexts which affect the transmission of the virus and the way in which communities cope with the consequences.

The United Kingdom is the largest donor to the World Health Organisation global programme, providing £7.75 million. In addition, we are supporting national AIDS programmes. The United Kindom contributes to the International Planned Parenthood Federation. Some £1.6 million goes towards helping its public education material. I have seen that operating in Nigeria and the Gambia. It is remarkable to see how effectively one can communicate in such countries and communities, and I commend the IPPF on its work. We also support the European Community AIDS programmes and our health assistance programme of more than £40 million a year is designed to strengthen developing countries' health services in dealing with the disease.

We simply do not know what will be the economic impact in sub-Saharan Africa, but the United Kingdom has commissioned research which is so important. Two types of cost will be involved - the direct cost for prevention and patient care, and the indirect cost due to lost output. That is particularly difficult to quantify because we do not know the extent of the epidemic or its effect. Populations may alter significantly, but we do not yet know what will happen. The balance between economically active adults and the dependent young and old may not change because the number of deaths from AIDS among young children may be greater than we first thought and the balance may be relatively undisturbed.

There is much work to be done bilaterally. In Britain, the Overseas Development Administration (ODA) is concentrating bilateral assistance on three- to five-year medium-term national AIDS control plans in priority countries and £5.63 million has been pledged in support of programmes in Uganda, Kenya, Tanzania, Zambia and Zimbabwe. Our support is channelled through the World Health Organisation.

Many people are anxious that the money should be spent in the right way. I believe that it is. In the absence of a cure or vaccine, priority must be given to education and information. However, other priorities that the British Government is addressing include protecting blood supplies, laboratory diagnosis, training and surveillance of the progress of AIDS. The Government also offers training on social aspects to developing countries in the form of a one-year postgraduate course leading to a PhD which will equip a person to return and work on the social impact of AIDS in his own country. It is surprising and unfortunate that very few candidates have come forward.

Above all we must continue to support family planning which brings enormous benefits to mothers and children, particularly in developing countries. The idea of a spaced family in a healthy community is good for the menfolk too. I thank the condom manufacturers and pharmaceutical companies for their responsible attitude to the pandemic. I am sure that they have all contributed in their various ways.

Britain led the world in public education through media campaigns and direct mail shots. There are now valuable innovative programmes being developed all over the world, including the developing countries. We should not be afraid to learn from them. In particular, there is a remarkable project in Jamaica which has successfully used calypso songs in its education. Of course, education need not be drudgery.

It is important that we all realise that AIDS is not a bleeding hearts issue. It is one of the toughest problems of the age. It knows no boundaries, but it still rates a low political parliamentary priority.

POVERTY, POPULATION PRESSURES AND ENVIRONMENTAL DEGRADATION

Too many people in the rich countries still think that the poor of the developing world are feckless because the rational behaviour of the individual does not coincide with the good of the local or the global community. Very poor families have so many children in large part because so many of their children still die before reaching puberty. If development efforts and aid programmes have one overriding purpose, it is to stop so many bebies dying. That does not just need primary health care programmes but sustained increases in incomes and improved sanitation, agriculture, education and the rest. In fact measuring impact through infant mortality is a good way to measure whether real progress is being made.

It is the same with environmental degradation. Poor people do not deplete their resource base out of perversity. As experienced farmers, the rural populations of developing countries know only too well the consequences of overusing marginal lands. But they do not have resources on which to fall back in hard times. There is no cushion from the European Community's Common Agricultural Policy (CAP). Their savings are not put into Volvos or BMWs but take the form of trees or cattle. Once those are gone, survival itself dictates two choices. Help a family to find a way out of dire poverty today, and sustainable use of resources tomorrow becomes a possibility.

Poverty and population pressures, which are increasing faster than peoples' ability to adapt systems of production, are very powerful causes of environmental degradation. It is no wonder that the symptoms of that degradation are so alarming.

Deforestation and Its Consequences

Sir Sonny Ramphal properly drew attention to tropical deforestation and quoted the FAO figure of an annual loss of 11 million hectares. That figure represents an area the size of Scotland, Wales and Northern Ireland. It is the most widely quoted because it is the latest we have for global forest loss drawn up from internationally comparable data. However, it relates to 1980 and certainly underestimates the present position. Figures for the last burning season produced by the Brazilian Space Research Institute suggest that that country alone lost 30 million hectares of savanna woodland and rainforest in 1988.

But let me move on from statistics to their consequences. Why does such destruction matter? After all, deforestation was so widespread in Russia and North America in the 1860s that it was then the biggest emitter of carbon dioxide to the atmosphere. The consequent expansion of agriculture provided the basis for subsequent industrialisation and growth.

Unfortunately, as we all know from horrifying television programmes, today's burning of the rainforest is unlikely to have such prosperous results. The soils below the lush vegetation of Amazonia are mostly fragile and poor. When the forest is cut down and burnt, the ash gives a once-for-all boost to the soils, but the minerals are soon leached out. The poor migrants from the drought-ridden north-east of Brazil or the slums of its large cities all too often find that their dreams of abundant crops on a secure homestead are an illusion. Their back-breaking work has merely cleared land for absentee ranchers. Even pasture deteriorates and ten years after clearing much of the land is hard-baked desert or scrub unpalatable to cattle.

The cycle would be tragic enough even if the original rainforest were not a resource of global importance. Because almost all the insects have yet to be identified, no one knows whether rainforests harbour two or 50 million species! We do know that the complex ecosystem of the forests means that many of the species are highly adapted to their ecological niche and have unusual and therefore valuable properties. It is no accident that 40% of all drugs prescribed in the United States of America are based on chemicals derived from rainforest species. Nor is it accident that the US National Cancer Institute has identified 2,000 rainforest plants with the potential to fight cancer.

Darwin taught us that species loss is an inevitable part of natural selection. Probably 98% of all the species there have been over the past 400 million years are now extinct. But that works out at one loss every 27 years. Burning of the forest for unsustainable agriculture means we are losing species at a rate of two a day. If the World Resources Institute is right and we lose 13,000 plant species by the year 2000 from Latin American rainforests alone, our wanton destruction will be more than careless, and our descendants will talk of calamity not misfortune.

Genetic diversity means the rainforests are particularly important. But all deforestation is a global problem. Forest burning contributes between 10% and 20% to net global carbon dioxide emissions. So while power generated from fossil fuels (and most power is generated in rich countries) is by far the most significant source of greenhouse gases, we cannot afford to ignore tropical deforestation in our studies of possible climate change. There is evidence to suggest that deforestation in Amazonia and West Africa also affects regional weather patterns and rainfall.

The British public is most concerned about loss of rainforests. But as an aid donor concentrating on the poorest countries, we are at least as worried by loss of forests from more arid areas. The importance of trees in such areas was graphically described by a Somali pastoralist:

> "Villagers have no factories or industries. We have land, we have water and after that we need trees. Allah created trees because animals need them, just as people need land...our lives depend on our animals and they depend on trees.
> The trees save our lives in drought.
> Trees are male camels for us - they bear our burdens."

In the west, "energy crisis" means sudden shocks in the price of oil. In Africa, it means shortage of fuelwood whose price, assuming it is available at all, is measured in women's time. As wood becomes even more scarce, dung is burnt instead. That means essential nutrients are no longer available for crops. The crops foregone each year because of that loss of natural manure may well be greater than the annual total food aid provided by all the world's donors.

The degradation does not end there. Organic matter and trees both help to prevent soil erosion. The World Bank estimates that to make up the nutrients carried off by soil erosion would cost India $6 billion in replacement fertiliser each year. That is 45 times Britain's substantial aid programme to India.

Soil degradation wreaks appalling human misery. The Horn of Africa has had more than its share of suffering in the 1980s. Displaced people trek back and forth across hostile land. We are faced with the heart-rending sight of starving babies in feeding camps - that appalling symbol of the failure of every sort of development, political as well as economic. The immediate causes are war and drought, but at some level these are environmental refugees. It is no coincidence that Ethiopia's descent into vulnerability to famine follows the stripping of forest cover from the Highlands. Ethiopian forests now cover one tenth of the area they did in 1900. Lands stripped of their tree cover cannot retain what moisture there is. When rain comes, it is not absorbed. We are faced with the mocking spectacle of disastrous floods in areas usually regarded as arid wastes. When life is precarious, people are more likely to fight over precious water and pockets of good soil. Tribal loyalties become more important if group survival is in question.

So even one type of degradation - deforestation - can have profound consequences: loss of genetic diversity, climate change, loss of soil fertility, soil erosion, flood and famine.

That is an apocalyptic list but we must not be paralysed by doom and gloom. Asked once whether he was an optimist, Winston Churchill said he didn't see much point in being anything else. What we need is to be imaginatively, practically and resiliently constructive. Indeed, that is the whole value of the Brundtland Report. The earlier Club of Rome was politically, not to say economically and technologically, naive in insisting that we must all give up the benefits of 20th century affluence. By preaching "No Growth", they ensured they had "No Influence".

THE BRUNDTLAND REPORT'S PROPOSALS FOR DEVELOPMENT

The World Commission chaired by a serving Prime Minister and including eight Ministers or former Ministers was much more astute and realistic. The Report does not say "carry on as you were", but it does give a message of hope. It points to sustainable growth and the elimination of poverty as the basis for an environmentally sound world. It asserts that technologies can be found if the will exists. Faced with that approach, which politician will dare cast doubt or refuse to take up the challenge?

Sustainable Development: The Need for Political Will

I believe profoundly in the importance and possibility of sustainable development. It is, of course, difficult to define simply, but it was neatly characterised by the Brundtland Report as meeting the needs of the present without compromising the ability of future generations to meet their own needs. To bring that about requires three things. It requires political will, resources and the right mechanisms.

Political will appears to be available in developed countries and in some developing ones. Prime Minister Thatcher's speech to the Royal Society in London last September made her personal commitment quite clear and showed that growth and environmentalism go together. She pledged:

> "The Government espouses the concept of sustainable economic development. Stable prosperity can be achieved throughout the world provided the environment is nurtured and safeguarded."

President Bush stressed environmental issues in his election campaign and Budget Address and has nominated the President of the American World Wildlife Fund as head of the US Environment Protection Agency. President Gorbachev, who has a background in agriculture, apparently has plans to double expenditure on environmental protection by the early 1990s. President Mugabe and Prime Minister Ghandi both chose to take part in the United Nations debate on the Brundtland Report.

Two swallows do not, alas, make a summer. Other developing countries will need to follow the lead taken by Zimbabwe and India and, without in any way belittling the achievements of these two countries, rhetoric from the South is not enough. There also needs to be action on both global and local problems. As I have argued already, that is more difficult for developing countries than it is for us. We can and we must help to generate the necessary political will.

To have any credibility at all we need to show that we are solving our own local problems in the West. I call this the older greenhouse effect - people who live in glass houses shouldn't throw stones! Developed countries must adopt the right policies to deal with both global and local environmental issues. Secondly, we need to make it clear that we recognise that global problems impinge in different ways in North and South. We may worry about the contribution of forest burning to carbon dioxide emissions, but developing countries will rightly point out that the North's demand for thermal energy is the main culprit. They will emphasise the enormous scope for energy saving in the North. They will insist that they should not be penalised for their present poverty, but should be given the freedom to develop and to industrialise. If energy efficient and environment friendly industrialisation demands higher initial costs, developing countries will push their own priorities such as more open markets so they can earn the necessary resources to afford action, as well as, for the poorest, more effective aid and more of it.

To encourage the cooperation of developing countries in solving global problems I think two conditions will need to be satisfied. First, poor countries will need to be sure that the richer nations have done all they can to solve their own problems. Secondly, richer countries for their part will need to show appreciation for recipients' domestic concerns. By embracing help on factors which contribute to the global problems and help for a local environmental issue, such as soil erosion or fuelwood shortage, both partners should gain. In both cases, the path forward will need to be found in ways which also allows poor people and poor countries to improve their material well-being.

Some have tried to short-circuit this cooperative building of political will. They have argued for using blanket environmental conditionality against developing countries who seem to be ignoring the global environmental good. I certainly believe that one should encourage environmental concern in aid recipient countries, for example, by trying to persuade them to give forestry projects a higher priority. This is an example of the policy dialogue that is such an important instrument for ensuring that our aid is effective. Equally, it is right to make specific project conditions about pollution standards. What I oppose is the argument which says one should cut off all aid to a country which cuts down its forests. That smacks of sanctions. If we do not help countries to develop their resources sustainably and to find alternative livelihoods, it is all too likely that they will pillage their existing resources even faster.

Equally I cannot agree with those North American pressure groups who seek to make progress by imposing their own domestic environmental protection legislation on development projects. For one thing, it's bad ecology. Standards set for temperate, highly urbanised environments may make no sense in tropical rural areas. For another, it wrongly assumes that developing countries have the basic data and monitoring capacity required. A more constructive approach is to strengthen institutions in developing countries so they can decide on appropriate standards, monitor them and enforce them. We are doing just that ourselves, for example, by financing a number of trainees in environmental disciplines. It might seem to take longer than conditionality, but the results will be much more sustainable.

Sustainable Development: The Availability of Resources

So much for political will. What about resources? That is not just a question of money. It is important to remember the Brundtland Report's strong message that environmentally sensitive development could often reduce costs.

The first need is to follow Prime Minister Thatcher's dictum in her Royal Society speech:

> "We must ensure that what we do is founded on good science to establish cause and effect."

I suspect that we would be surprised to learn how many gaps there are in our understanding of tropical ecosystems and of the interactions of development and environment. Sadly, a lot of the research the British Overseas Development Administration and other donors need is not very glamorous. No one has suggested a Nobel Prize for those who made the oral rehydration therapy salts used to combat diarrhoea cheap enough to be distributed on a massive scale. Yet the problem was not an easy one and I suspect the benefit to mankind outweighs that from some much more prestigious science.

One area requiring much attention is improving the genetics potential of trees which are hundreds of years behind agricultural crops in terms of selective breeding. We need to start by taking and labelling seed of known provenance. As I say, hardly glamorous work or the way to a quick PhD, but it is essential for all that.

To encourage more emphasis on forestry research of all types, Britain has recently announced an additional £500,000 a year for international collaborative work. We shall be using part of that for a study by the World Conservation Monitoring Centre which is in Cambridge, England. The Centre will be making a special study of protected areas when FAO updates those obsolete deforestation figures I mentioned earlier.

One area where our understanding is particularly weak is on the extent, expected trends and strategies for coping with desertification. A UN Conference on Desertification provided the opportunity for a baseline assessment in 1977 which was followed up by a questionnaire from the United Nations Environment Programme in 1984. The latter was based on a broader definition of the area at risk. Yet a comparison of the two has provided virtually all the widely quoted statistics on desertification used ever since. A whole United Nations Plan of Action to Combat Desertification was drawn up on the basis of the 1977 figures. The Plan calls for inputs of more than $4.5 billion each year but has never received backing on anything like that scale.

In Britain the ODA has always preferred to tackle desertification as part of natural resource management, rather than as a separate problem with its own priorities. The latest analysis from Ridley Nelson of the World Bank suggests we were right and claims that there is little point in throwing huge sums at what he prefers to call dryland degradation. The new study questions the scanty data and rejects the old concept of steadily advancing sand dunes moving southwards from the Sahara. Instead, Nelson claims that, after allowing for fluctuations in rainfall, deterioration flows outwards from centres of population pressure. So the problem may be as much socio-economic as climatic. The study urges new localised adaptive research and rejects the famous grandiose plan to put a green belt across the Sahel from Dakar to Djibouti. Faced with such contradictory advice a decision-maker could be forgiven for prevaricating and calling for more research!

The emphasis on science needs to involve developing country scientists, especially on work on global problems. We can expect the Governments of India or China to be more heedful of predictions on global warming if their researchers have played a part in formulating the assumptions or processing the results. We need to build a world scientific constituency which can sensitise decision-makers in North and South alike.

Apart from - or perhaps as a part of - good science, we need good economics. It is crucial that those worried about the environmental effects of projects and policies should talk the language of economics if they are to influence Ministries of Planning and Finance in developing countries.

Some people used to object to cost benefit analysis on the grounds that it did not take proper account of the long-term future, nor of factors which could not be quantified. Both points are important in assessing the environmental dimension of projects. However, we still need a mechanism for allocating scarce capital amongst the developing world's possible projects. The British ODA has commissioned a practical handbook on integrating environment in project analysis. The text will compliment a general manual that Britain has just produced for all our programme managers, which is intended to ensure that the environmental dimension is properly considered throughout the project cycle.

Apart from micro-economics we are working with the World Bank at a more "macro" level. We have commissioned British consultants to study the trends in the supply of and demand for natural resources in the hills of Nepal and to explore the possibilities for encouraging environmentally appropriate behaviour through macro-economic and other policies. The study is based on the World Bank's premise that degradation in developing countries is too widespread to be tackled by projects alone. The first phase suggested that on some reasonable assumptions food, fuelwood and fodder deficits would be common throughout the hills by 2011 and might have an economic cost per head of as much as $60 to import substitutes from outside the hills. The top figure is a third of current GNP per head. No wonder the Nepal National Planning Commission has shown great interest in what started off as a donor initiative and has played a major role in selecting the policy instruments to be analysed in the second phase. The World Bank is financing similar work in up to 29 other countries. The series should provide some much needed insights into the true causes of degradation.

Good science and good economics should help us make best use of the third kind of resource, money. They should also remind us that throwing money at a problem may not solve it.

The most obvious way to promote sustainable development is to ensure that consumers and producers pay the full environmental cost of their activity. We all know countries where demand for electricity is almost infinite because tariffs are set very low or charges are not collected. The results are unnecessary thermal power stations and an environmental cost to all of us. It is not always easy to ensure that the market reflects full environmental cost, but we can make a start by eliminating harmful subsidies.

Those subsidies can take many forms. The European Community's Common Agricultural Policy (CAP) and the agricultural support systems of the United States and Japan conspire to ensure world prices facing many developing country commodity exporters are very low. That increases their need to deplete their resource base more quickly and it reduces their ability to afford environmental protection. I am not saying higher prices would automatically improve the environment - they might instead lead to increasing production on more marginal land (as the CAP has done). My point is that more open agricultural trade is a necessary, though not a sufficient, condition for sustainability.

The argument is not just true for agriculture. Trade has a much bigger impact on developing countries than aid ever can have or should have.

We also need to think about debt in our effort to find resources for environmental protection. We have always rightly distinguished between two types of debt. The first type is that owed by the very poorest countries to governments and the international financial institutions - basically the debt of sub-Saharan Africa. The other type is that owed to commercial banks by the better-off developing countries, and here I am thinking primarily of Latin America. We launched some 18 months ago our initiative on African debt and, thanks to the breakthrough achieved at the Toronto summit, Paris Club rescheduling is now under way, reflecting the Toronto consensus. Seven countries have already benefited. The problem of Latin American debt is again under active discussion. Our approach to this problem is to avoid two particular risks. We do not want to transfer the problem from banks to taxpayers not do we want to deter the banks from investing in these countries again. Too many of the many of the proposals made so far have this effect.

Some environmentalists want to bring in additional resources through debt swaps. Where debt swaps bring in genuinely additional resources, they can be a useful tool. But I am inclined to be sceptical of the potential here. After all, why should a government agree to the conditionality involved, if it was barely servicing the debt before? Where secondary markets are thin, activity by "debt swappers" can raise prices and deter other potential purchasers. If non-governmental organisations (NGOs) provided large sums of money for this, they would be obliged sooner or later to face up to the question of sovereignty.

I come then to aid. Britain's Overseas Development Minister, Mr Chris Patten MP, has made it clear that, as far as we are concerned, official development assistance of the right quality, properly spent, is an essential part of the cooperative effort to find resources for sustainable development. The British economy is now sufficiently strong for us to start increasing the aid programme again in real terms. I hope we can go on doing so.

We must also look for ways to focus our aid effectively. Demonstrating our environmental concern, Prime Minister Thatcher pledged that the ODA would: "direct more of our aid to encourage the wise and sustainable use of forest resources".

The forestry initiative has four components. I have already mentioned the additional aid for forestry research. We are encouraging recipient countries to direct more of the aid we provide to forestry. We are currently completing an exercise to identify countries where we feel we can have a comparative advantage in offering forestry assistance. The British Overseas Development Minister has also just announced an annual grant of £1 million to the World Wide Fund for Nature for jointly-funded projects. Both sides agree that more than 70% of that should go to forestry conservation projects. The final component is training and institution strengthening. We have world-renowned expertise in tropical forestry in Britain. We intend to use that expertise both to strengthen our in-house capacity to appraise and monitor forestry projects and to provide technical assistance and training for our increased effort overseas.

Sustainable Development: Strengthening the Mechanisms

I turn now to the mechanisms for global sustainable development. By mechanisms, I mean the international institutions.

For over 40 years, international relations have been dominated by the consequences of an experiment that Rutherford conducted in Cambridge, England in 1919. I understand that when he split the atom he thought it would be of no practical use. I am told he continued to think so until his death in 1938. However, nuclear weapons, the Cold War and disarmament have shaped alliances and preoccupied governments since the 1940s.

I believe that, over the next 40 years, trade and the environment will come to form much of the business of international relations. Environmental questions will provide diplomats with plenty to do, not least because solutions will be extremely hard to find. Negotiations about nuclear weapons take place in well-established fora; they revolved around a relatively restricted number of reasonably well-understood problems; and they involve, for the most part, only a few key countries. On the other hand, there is a huge range of both global and local environmental problems. We do not fully understand the ecological principles at work. All countries have a stake in the solutions. And all need to be involved in finding them.

Inevitably the arguments about global environmental questions are bound to involve issues of national sovereignty and equity. They will not be easy to solve.

For example, I referred earlier to the genetic diversity of rainforests being of global importance. Very few political leaders would draw the conclusion reached by the Indonesian Minister of State for Population and the Environment, Emil Salim, who was a distinguished member of the Brundtland Commission. He has described the rainforests as a global resource requiring and deserving finance from all nations for their protection. This is not the view of the Brundtland Report which confined the global commons to Antarctica, the Oceans and Space.

A more usual reaction would be that of Brazil which has been very jealous of its national sovereignty and territorial integrity ever since Spanish and Portuguese disputes over the Treaty of Tordesillas. In Brazil, rainforest has hitherto been regarded as a purely national resource to be used in accordance with national priorities. Interference by outsiders is deeply resented although at the same time international opinion seems to be having an effect in raising local perceptions of the value of Amazonia.

A local Brazilian Senator reacted to a visit by five American Senators and Congressmen in January 1989 by writing in a Sao Paulo newspaper:

> "If, on the one hand, the presence of these arrogant would-be lords of the earth tramples on our sensitivity, on the other, it shames us that we have no strategy to exploit Amazonia in a way that preserves the environment."

Recently President Sarnay has been even more blunt:

> "No foreign money can buy a single square metre of Brazilian Amazon soil."

Respect for national sovereignty means concerned donors have so far provided money for conservation mainly as part of traditional aid programmes. So projects have happened only when recipient governments attach priority to them. It may be difficult to increase the priority given to environmental projects when local people are crying out for schools or health care.

Sovereignty poses other problems. Efforts to stop the depletion of stratospheric ozone by chlorofluorocarbons (CFCs) have come about through persuasion and diplomatic negotiation. The Montreal Protocol marks a real breakthrough in international negotiation on environmental issues. But not all countries are involved. In particular, China and India, which have the potential to be major producers of CFCs, are not signatories. In an effort to persuade all the non-signatories that CFCs pose a real threat to every nation, the British Government is hosting a major international conference on Saving the Ozone Layer next week. I believe we have good arguments and I very much hope that more countries will decide to join the Protocol. But in the end there is no supranational body which can compel them to do so.

Some might like one, and the temptation will be even stronger if industrial emissions of carbon dioxide raise world temperature and bring floods to capital cities in the northern hemisphere. But in the real world countries only cede sovereignty if they perceive it to be in their own interests to do so.

The dimensions of political units do change over time. 1200 years ago I would have crossed a national frontier to get to London from my constituency in Salisbury. In 1200 years we have more or less united that simplest of geographic entities - offshore islands. We have joined our partners in the European Community (with whom we share living standards and much history) in a lively debate about the appropriate limits to sovereignty at different levels of decision-making. That experience should teach us the wisdom of proceeding pragmatically. Let no one kid themselves that we are ready for a culturally and climatically diverse global village to be ruled by an environmental policeman.

CONCLUSION

The world's environmental plight is too important and too immediate for problems of national sovereignty and daydreams of supranationality to waylay us. We have not time for windy generalities and vapid pieties. We must not waste years in wrangles about new institutions. We must use what we have. We must look out for and build on practical initiatives. It may not suit those in the green movement who want to overturn the human world in order to preserve the natural one, but our approach must be heroically prosaic.

The successful work done to date on CFCs shows a way. The Tropical Forestry Action Plan with its emphasis on practical coordination and frank discussion is another model. The Inter-governmental Group on Climate Change has made a successful start. The United Nations Environmental Programme, fresh from its Montreal Protocol triumph, is poised to secure agreement on a Convention on the Transboundary Movement of Hazardous Waste.

All these initiatives share two features: a substantial British involvement and a connection with the United Nations system. The UN is all too often castigated as a talking shop, but it is the most appropriate forum we have. If it did not exist already, we should need to invent it. But why on earth try to invent it twice over? The UN already has institutions dealing with the environment, social issues, refugees and agriculture. It is up to us to ensure that the UN functions as effectively as possible if we are to achieve sustainable development. That, naturally, begs a host of questions - but we would be better served trying to address those than engaging in the attempt to build new castles in the air.

Other institutions must also play key roles. I have mentioned the World Bank a great deal. Environmentalists, especially American ones, love to suggest that its only green interest is the greenback. It certainly helped to finance some projects which went disastrously wrong, as its greatly strengthened Environment Department would be the first to admit. But criticism tends to centre on six of the literally thousands of projects its has helped finance. The Bank is now, as befits its stature, the leader in environmental research and policy initiatives amongst the donors. We keep closely in touch with the Bank's thinking, as the Nepal study demonstrates.

Environmental collaboration between bilateral (country) donors is growing through the Development Assistance Committee of the *Organisation for Economic Cooperation and Development (OECD)* in Paris. Environmental expertise is in short supply and we can usefully share experienes with each other. We also need to discuss together how to handle certain types of project. If global warming means that we should take more explicit account of greenhouse gas emissions from power stations in our economic appraisals, then we will obviously have to decide guidelines with other donors. Otherwise, if we suggest to a recipient that an energy efficiency project might make more sense, all that is likely to happen is that the recipient will take the efficiency project from us and ask another donor for the power station.

I recall the classical European legend of Pandora's box. Epimetheus opened the beautiful box, given to Pandora by Jupiter. When Epimetheus lifted the lid,

> "there issued from it a multitude of evils and distempers which dispersed themselves all over the world and which, from that fatal moment, have never ceased to afflict the human race. Hope was the only one who remained at the bottom of the box..."

At the risk of abusing the fable, we don't want Hope to remain under wraps. The job for politicians in the next few years is to get Hope to fly. We shall of course save the earth. There is no option.

Mr. SCHEUER. Thank you very much, Robert Key. I hope we will save our earth. The option is to let it continue to degrade to the point of utter disintegration.

Barbara Tuchman wrote a book on wrong decisionmaking, wrong-headed decisionmaking, and half a dozen or a dozen instances that had devastating wrong decisionmaking by chiefs of state, that had devastating consequences for that nation, and some of the nations disappeared as a result or were maimed and wounded dreadfully.

It is possible that that will happen to us. We've heard some doomsday scenarios from other witnesses here of where the population of the globe could end up. We're all in this together and we'll all suffer if we don't change, but every one of you has said that we aren't applying our intelligence, we aren't applying our insights. And I hope you're right. I don't think it's a given that you are right.

Just to sort of personalize this a little bit, one of the chapters in Barbara Tuchman's book was about the horrendous and egregious error of King George III in his treatment of the colonies. His ministers told him, one after the other, stop treating those colonials so badly. They're not going to take it indefinitely. He was determined to pursue that policy. He did pursue that policy. We broke loose, and the consequences for good or ill are evident. Who knows whether it was the right thing to have happened? From England's point of view, I'm not sure. I'm not even sure from our point of view.

Ms. SCHNEIDER. I am.

Mr. SCHEUER. I would welcome you in our Congress, so long as you stay the hell out of the Eighth Congressional District in New York.

[Laughter.]

I hope you're right, but I say that with a note of trepidation in my voice.

Mr. MITTAL. You know I'm agreeing with you, not disagreeing. When I say this, you know, I'm agreeing with you.

Mr. SCHEUER. Yes. When Sat Pau Mittal shakes his head no, he really means yes.

[Laughter.]

Robert Key, yesterday, Tuesday I guess it was, we had really impressive testimony from Maurice Strong, the first Director of UNEP, the United Nations Environment Program, a man who has considerable experience in industry and international finance. He's a very large-scale business leader.

Mr. HALLIDAY. A Canadian, too.

Mr. SCHEUER. Canadian, too. Yes, indeed.

He's a very sophisticated financial mind. And he advocated that one approach to Third World debt would be to take the existing Third World debt and reduce it to what its real value is, which means a cut of 50 or 60 or 70 percent, and then subordinate it to new debt. Leave it in there at its current real value, subordinate it so that the banking community would be willing to make reasonable new loans to Third World countries that would have a senior claim on their national income, and which could be serviced by reasonable projections of their increased gross national product flowing from the beneficial results of the development.

He advocated as part of that, that they would agree to join the developed world in achieving a consensus that we all had to raise our standards of environmental behavior, and that all development, whether it's agricultural development or economic development, had to be on a sustainable basis.

He would have said about Brazil, and perhaps he did, of course, Brazil has to mine those forests; of course there has to be some current income to Brazil from the marvelous stands of mahogany and other valuable trees, but it should be on a sustainable yield basis, so that from the world's point of view we don't destroy that priceless heritage of tropical forests wherever they exist, including our own tropical forests in the United States of America where our malfeasance matches almost anybody else's. And he thought that was a workable deal and it's the principle of debt for nature, helping the Third World, subordinating their existing debt after writing it down some, so that the banking community would participate in making further loans for development and establishment of a common consensus that we all had to improve our behavior, because there are mistakes all over the place, and no portion of the developed world has a right to look down their noses or point their fingers or engage in blame-saying to developing Third World countries.

For generations we were the bad guys, we were the chief malfeasants. At a time when most of the developing world was functioning on a sustainable basis, we were desecrating our land, our water, our air.

So I'd like to hear from the whole panel because the question of Third World debt which you properly raised is an important subset of the food and population conundrum. If we don't learn how to match food with people on the basis of agricultural policies that are sustainable, that don't degrade the land, don't degrade the water, don't degrade the air, don't produce acid rain, don't produce a greenhouse effect, don't produce desertification, don't produce deforestation, don't end up in the destruction of tropical rainforests, we're all in the soup and your hopeful projection may not turn out to be written in the stars.

I'd like to hear from you and the other members of the panel on any thoughts you may have on the whole question of debt for nature. How do we help Third World countries cope with their Third World debt so as to, at a very minimum, avoid these horrendously destructive results of Third World debt on social services, on health services, on education, on job production, so that not only are per-capita GNPs reduced, not only has there been this horrendous increase in infant mortality—the UNICEF says a half a million extra children a year dying at birth who wouldn't have died were it not for Third World debt—a half a million women a year dying in childbirth who wouldn't have died if it weren't for Third World debt, but at the same time that's going on, their population is increasing. The population increase is accelerated because of the cutting back of education, the very education and family planning programs that could have moderated population growth.

So this is an accelerating satanic dance toward destruction. How do we break that cycle and bring rationality back to agricultural development and development in general in the Third World? How do we liberate them so that they can place that with the banking community, and how do we achieve some kind of rational sanity to achieve equilibrium between food and people in a way that is environmentally benign or, even better yet, environmentally supportive?

Mr. KEY. Well, debt for nature swaps are an intriguing manifestation of the frustration of ordinary people, of the failure of politicians and governments. If the governments won't solve the problems, then a non-government organization will be formed and will put pressure on them and will go and do it themselves.

But there you find that if governments don't then respond, you run into problems of sovereignty. I fear that debt for nature swaps will only work at the margins of the problem.

The amounts of money raised by NGOs and charities, considerable though they are, are, I suspect, not enough to solve the whole problem. And there are severe problems with the technicalities of debt swapping.

I think perhaps the first obvious problem we have to recognize is that environmental problems have different impacts in developed and developing countries, but solutions pose completely different degrees of difficulty.

You see, in the developing world we have choices, we have options, we have a scientific base, we have resources. But we are asking the developing countries to do the impossible. They face similar problems with fragile ecologies: uncertain weather, poverty, rapidly expanding populations, lack of qualified manpower, and a narrow scientific base. That illustrates beautifully the necessary interdependence of the developed and the developing world where we share a common interest and where we can actually find the solutions.

I am unashamedly optimistic about this. If we can overcome some of the political problems that we share, then we can begin to find the right solutions and they are really very basic solutions.

Gone are the days when we should be seeking to build flashy airports and motorways. What we have actually got to get into is solving the problems of crops and solving the problems of water and solving the problems of sewage in order to help developing countries to help themselves.

Ms. SCHNEIDER. I have one regret about this hearing, but it's a substantial one. That is that I think that everyone in this room, not only the witnesses and the chairman and myself, but perhaps the people in the audience there who are shaking their heads yes, yes, yes, I regret that we are all preaching to the choir at this moment.

And I only wish that I could have taken each of you and put you in different rooms and have talked to some of our colleagues and said, "This is the way the world is," because the chairman and I feel oftentimes like lone voices in the wilderness trying to—as I am sure each of you do in your respective parliaments—trying to persuade our colleagues that population, environment and solution on a grass roots level through NGOs are the way we are going to get speedier action.

I happen to share your optimism. I am probably more enthusiastic this year than I was last year, and that is almost unbearable for most of my associates. But the fact is that I have reason for optimism because I can see on a global level and also in a microcosmic way, how there is a consciousness shift taking place right now. It is for real. And I think that we need to use this momentum, this opportunity, to move our agenda as quickly as possible.

Let me say that you made a remark, Mr. Key, about the whole question of population, population funding, and you wonder about the morality of people allowing masses to die of starvation. I share that philosophy.

I have not been able to get through on that point to any of my colleagues, but perhaps this is a message that ought to be communicated through your own efforts, through some of the churches. Perhaps you have argued this point and maybe I can learn about some of your point-by-point arguments because we have run up against a brick wall.

I say that in a very timely way because I have introduced a global warming bill in the Congress, of which the chairman is a cosponsor. What makes the bill unique from all the other bills on global warming is that mine is the only one that does an analysis of what the causes of global warming happen to be which are, by the way, people; and it provides solutions ranked on two accounts. One, we rank those least costly as being the best solution and, two, those with the least environmental impact. And when you cross-reference those, the ones that come out on top are the kinds of energy policies that we should be pursuing, which are least-cost energy options.

There is a component in here on population and also a component on the foreign aid element. And the part on world population growth provides a five-year authorization for family planning services of $2.78 billion.

Well, I've just learned today—and I'm going to need your help on this—that a number of my colleagues are calling now and saying they're going to get off of my bill, they don't want to be part of it because of the population segment of the bill.

Now, I have made it very clear that what we are doing is providing information, information transfer, and there is a belief that developing countries don't want or need, and it's not our responsibility to provide that information. This legislation has no provisions for abortion, nothing of that nature, strictly information transfer. And yet I am seeing an exodus from participating in this bill.

So this is the dilemma that we have to face here. We could certainly use your cooperation and support and I have put together copies of these bills that I'm going to give to each of you, because in my thinking, if you take these bills back and you find pieces that you think are appropriate for your own countries, then if you are to introduce them there, that raising of consciousness globally will happen much more quickly. And this is one of the efforts that I'm trying to do with this bill, that it's not going to be the Claudine Schneider bill alone, but we're going to give pieces to different members so that they can move these agendas jointly.

So my one request is for you to share with me some of your arguments on the morality question, and to also know that we have a major battle here in the House, and also to say that I concur with your assessment of the problems of deforestation and loss of species. Where do we go from here?

I've been throughout the Amazon, I've been to Madagascar which is one of the most biologically diverse countries in the world. I passed legislation last year calling for an international conference on biological diversity that our president will have to convene. It passed.

By October of this year, he will have to come back to the Congress and provide us with the game plan, the time and the agenda and everything else. So I've been over to the White House this past week, making sure that they move according to schedule, which means that all of your countries will be participants in an international conference on biological diversity.

What I am urging you at this time is to have a heads-up, to be aware of this coming down the line, and make sure that we integrate all of the topics of the interrelationship of population and development and resource depletion, et cetera, in that whole conference, because many of our colleagues think that population has no role in an environmental bill. Well, maybe they have been sleeping for a while, but I think that we still have to do some persuasive arguments in that respect.

I'd like to ask a question. You mentioned that you are increasing the NGO monies by 40 percent. Are there any other efforts afoot? Is Canada putting an increased effort on NGO participation by chance?

Mr. HALLIDAY. I think it's fair to say that for the last year or two there has been a marked increase in the emphasis on NGOs. I can't tell you exact amounts or percentages, but I think we're adopting that same concept.

Ms. SCHNEIDER. I think that your remark earlier certainly would be a good point of discussion insofar as what ought we to do if the NGOs are coming up with some solutions and additional remedies to deal with Third World debt, beyond debt swap. What are some of the other models that might be appropriate to solve our collective problems?

[Pause.]

We still have to work on them.

Mr. KEY. Sorry. Is that directed to me?

Ms. SCHNEIDER. It's directed to any member of the panel that chooses to answer it.

One of the things that I've been pushing is the multiple use of forestry, and this is being picked up. But once again, I think that one of the keys that we might push for, particularly since our own debt in this country is also being financed by other nations around the world, we have to figure out what we can, and as the pressures come for us to reduce foreign aid, we have to figure out how to stretch those dollars that we do send, in foreign aid.

Mr. KEY. I would like to just make two comments. I think the first is that it's very difficult to see donor countries using aid funds in debt swap arrangements. Government participation in secondary debt markets may give rise to moral hazard problems because it may actually appear to give an incentive to debtors to default. Indeed, they would be stupid not to in those circumstances. I have every sympathy with them. That, therefore, is a very severe difficulty.

There is another one, too; that many countries with substantial debt are not sufficiently poor to be receiving bilateral aid anyway. Often in the United Kingdom we are criticized for not being sufficiently interested in the Latin American debt problem. There is a simple reason for that; that our overseas aid in the U.K. is targeted, first and foremost, to the poorest countries of the world which actually rules out most of Latin America and South America. And, secondly, it's targeted at our commonwealth partners who happen to be amongst the poorest nations, and so that's a very practical reason why we have a problem with that.

Ms. SCHNEIDER. Well, it seems that internationally, our strategy seems to be both crises management, which I think is the situation we're dealing with in Africa, but also preventive maintenance which is what we're dealing with in Latin America; that as we're seeing a loss of tropical rainforests and the development happening at the rate that it is in South America, we might see that continent become more like Africa.

So it is difficult. I mean we only have so many dollars. And so, as the international community, we have to figure out how to target it.

Mr. SCHEUER. All right. Let me come up with a few questions I wasn't able to ask.

Sat Pau Mittal, you mentioned the green revolution which so dramatically increased food production in Asia and in your country. Last week, we received testimony from Dr. Robert Chandler, the scientist who developed the rice strains in the Philippines, in the Philippine Research Institute, which were the basis for the agricultural boom in the late '70s and which considerably leveled off.

He predicted that there would probably not be anything like the green revolution again coming down the pike to benefit Asia or Africa or Latin America; that perhaps some of the developments in genetic engineering would produce modest increases in production, but that we couldn't count on anything like the quantum jumps that we experienced from your green revolution a decade and a half or so ago.

If that is true and if the increase in agricultural production in Asia is in the process of leveling off, and if your population growth rate remains unabated, isn't the problem exacerbating and isn't the hope that you can continue to feed your people, or that you will be making progress in feeding your people perhaps an illusory one?

Mr. MITTAL. Mr. Chairman, as a matter of fact, you have taken up where I left it. I had said we are mining the resources of the earth and the sea and they are going to level off, if not in a decade, maybe in two or three decades. That is my dilemma, too.

And I think the fertility of the earth has its own limitation. The question is, like renewable sources of energy, are you going to have renewable sources of fertility of the earth? I'm afraid not.

So the question is, we have to do something to contain this explosion of population. Whatever we may talk about, we will ultimately revert back to the fact that this explosion has to be contained. And there is no alternative to the fact that something has to be done more quickly to contain the explosion, of course preparing ourselves internationally and nationally and locally to providing for the new arrivals also. You just can't say that you refuse to provide for them. At the same time, you have to see what is going to happen to this earth a decade from now, two decades from now, a half a century from now. You have to prepare yourself. The world has to prepare itself to meet that great challenge which we are seeing coming.

Mr. SCHEUER. Now, let's build on that. That great challenge, if we don't solve it, if we don't achieve equilibrium, is going to lead to real security problems, is it not, in some parts of the world—lack of food, lack of water, lack of arable land?

This has caused urban riots around the world.

Mr. MITTAL. Oh, yes. Malthusian theory.

Mr. SCHEUER. Yes, it is. It is.

When environmental degradation transcends national boundaries, it causes conflict between countries that have awesome security implications, implications for destabilizing of countries, of regions.

Mr. MITTAL. Congressman, only one comment to supplement it. When these earthquakes or severe droughts and floods come, causing devastation, I am only reminded of the Malthusian theory that probably we have reached a state when it has started showing its real face in its ugliest form.

Mr. KEY. Malthus is bunk.

Mr. MITTAL. Pardon me?

Mr. KEY. Malthus is bunk. It always was, it always will be, I am glad to say. And this comes back to the optimism I share with you, Congresswoman, because of course Malthus was totally unaware of the technological changes around the corner and of the intellectual capacity of the human race to adapt and advance.

I think that is a crucial point.

Mr. MITTAL. I am afraid, Robert, this world has been saying the visionaries who had predicted this doom of explosion of population coming in around two decades, we have been calling them agnostics. But they have proved to be visionaries. Don't corner him in that category.

Mr. SCHEUER. Robert Key, we have had a lot of evidence that Malthus may not be all bunk. The green revolution is tapering off. Increases in food production are tapering off. There is a growing gap between the growth in population and the growth in food production.

There may be some improvement, as I say, in genetic engineering, but not a quantum jump. We're not going to reach a critical mass, so to speak, as we did in the green revolution. One of you testified that we are going to have to increase the percentage of arable land that's put in production by 50 percent in the next few years, and I read all that testimony last night and today and I don't remember who said it. Which one of you said that?

One of you has in your testimony that we're going to have to increase the arable land that's under production by 50 percent.

Mr. MITTAL. I said that.

Mr. **Scheuer**. Okay. Now, I have no evidence that that's possible. As a matter of fact, some people like Lester Brown think we've got too much land under production, including land that is very marginal, land that shouldn't be under production.

Lester Brown says that we're farming too much, we're irrigating too much; that we're reducing water tables and that we're pressing land into production, straining fragile ecosystems to the point where that land disintegrates and then you have desertification.

This is an example of what you talk about when you say we're borrowing from our environmental capital. There is no way we're going to increase the amount of arable land that's under production by 50 percent.

I think many of the theorists say we probably ought to pull back a little and let some of the land that's under production rest and rejuvenate itself. As far as water tables are concerned, we've reached a peak. We are mining our capital at the rate in which we are depleting water tables. We have got to do less. Sometimes less is better. Less is beautiful. And in terms of depleting water tables, pressing land into production that shouldn't be into production, we may have reached the limit.

So if we don't have a massive effort at moderating population increase, we're in for some very, very hard times.

Yes, Bruce Halliday.

Mr. **Halliday**. No, I was going to get on a little different topic.

Mr. **Scheuer**. All right. Let me just ask a few questions that I want to ask for the purpose of the record.

We had testimony at our first hearing a week ago that P.L. 480, that wonderful law where we give away our food, is part of the problem in many ways and not part of the solution.

We heard testimony first of all that it couldn't be used in effect as capital. We couldn't use P.L. 480 food in food for work programs. In some parts of Africa, people want to work, they want to have pride, they want to show their independence, they'd like to work for food. Our law stipulates that cannot be done.

Maurice Strong told us that when he was heading up the Emergency Food Program for Africa with Brad Morse, the two of them, where there were communities in sub-Saharan Africa where young people wanted to work in exchange for food, they couldn't use food coming from the United States under our P.L. 480 program. They had to get food from European donors and donors from Japan, Canada, New Zealand, Australia and so forth.

So that was a basic problem in our P.L. 480 program. Another problem in our P.L. 480 program was the phenomenon that if we gave the food away, many countries would price crops in their country so low to please their urban masses, that it didn't pay the farmers to raise food for sale. They engaged in subsistence agriculture, so that country in effect relied on P.L. 480 and really didn't make what you would call best efforts to increase food production.

Do any of you see that as a problem that's inherent in massive programs for giving away food?

Mr. **Kwidini**. If food is given for free, if food is given for free it could actually have adverse effects. People begin to feel it is not really worth working. This is why many African countries have food for work projects so as to encourage them to work and earn it, instead of getting the food for free.

Mr. **Key**. It is absolutely crucial at this point. If you look at some of the poorest countries in Africa, if you look for instance at Ethiopia, you see that there is a new realism. You see the Ethiopian de facto government is actually preparing to invite in Western capitalist enterprises to grow plantation crops, as indeed they are now doing.

And this new realism is what I referred to earlier when I spoke, but since everyone here except me appears to be terribly gloomy about this, I feel that I must draw your attention, Congressman, to pages 13 and 14 of my submission where I address this point. And I point out that we mustn't be paralyzed by doom and gloom.

The value of the Brundtland report is quite simply that they're not saying, carry on as you were, but it does give a message of hope. You see, the Club of Rome was politically and economically and technologically naive and they lost momentum because they insisted we must all give up the benefits of 20th century affluence. And by preaching no growth they assured they lost their influence. Whereas the Brundtland Report, which after all was chaired by a serving prime minister and included eight ministers or former ministers, was pointing to the optimistic view of the importance of sustainable growth and the elimination of poverty as the basis for an environmentally sound world.

That is not unattainable. That is something politicians can and must achieve, and the technologies can and will be found. That is the challenge that we have to take up. I cannot accept the doom and gloom of some of my colleagues. I feel you only have to talk to the younger generation to realize that they have an enormous fund not only of expertise but of enthusiasm and optimism about this problem, too, particularly those who have actually served.

Congresswoman Schneider said, "What can we do" to her colleagues who refused to listen. I would say that the best thing that you could do is to get them a nice, big, comfortable USA air jet and take them to Africa, because there is no substitute for sitting under a mango tree with the village leaders and the imams and discussing vasectomy. You have the reality of the problem.

Ms. **Schneider**. Right on.

Mr. **Scheuer**. Well, of course, the very Members of Congress who ought to be on these trips to sub-Saharan Africa are the ones who don't go. It's the Claudine Schneiders and the Jim Scheuers who are constantly going, and it's just a bloody shame that we can't dragoon—

Mr. **Mittal**. Bring them to Calcutta.

Ms. **Schneider**. We'll work on it.

Mr. **Scheuer**. Do you have a sense—yes, Fred. Incidentally, you understand that when we finish the question period, you're going to be the home run hitter.

Dr. **Sai**. I understand.

But the question about food aid in particular, there has been quite a lot of volumes written about food aid. And one of the problems about food aid is really the reason for food aid from the donor country's point of view, because if it is to get rid of surpluses, then you start looking for pockets in which to put it. That is likely to be a problem.

The best food aid is when, like was mentioned, there is a critical need that would feed into development, preferably agricultural development, which the food by careful selection will be made to help fill needs. In much of West Africa, for example, oils, food oils are a very expensive and very rare item that will help bridge the calorie gap, that will provide energy and so on.

If you had food aid which brought in vegetable oils or even butter oil and these are put into commercial sale, they would be exchanged into currency at the market rate, and then that currency is used in the country for something else, it is not going to fail.

But if it is simply a case of we've got too much grain, we can't store the surplus, where can we push it, that certainly is going to depress some other country's production.

Mr. SOTOMARINO. I guess we're trying to put general rules to specific situations. In different countries, their economic realities and their potential productions are different. For instance, you have, as is usual in Latin America, a big city such as Buenos Aires or Lima in Peru, let's say this kind of case, and there is a market where the production can be made very close to this market or very far from the market, everybody in that country, in that state, has an equal right to come to market their products.

Their transport costs are very different. The problems of passing the Andes or not makes a great difference. Then their local government has to deal with taxes, taxes being lower the farther they are from the market.

Sometimes you realize that some of the production in some of the corners of the country come much more expensive to the market than could come from importing from other very far countries via, for instance, the ocean.

These kinds of problems are real in these kinds of countries. That's why they sometimes have to buy because they cannot overspend the monies they don't have. This is, let's say, one part of the problem.

The location of the energy in this kind of geography makes a possibility of industrialization in one place or the other. This is another problem dealing with great investments.

The other part is that the country people, the producers in the country, the farmers, are in general very ignorant. They cannot make, for instance, labor unions to compete with the labor unions of the cities where they press for the prices and they attack the others, the farmers all over the country.

So the problem is as different as the geography and the human conditions and the populations in each country. That is why organizations like the U.N. have to understand specific realities. Trying to get to common denominators is important to see what you have to import or what you have to produce in your country, in general believing in the laws of the economical geography.

We are in general, rural, in the country, so far from science, so far that we invent solutions. We invent solutions in general. Solutions are proving in these countries that they are not correct.

Mr. SCHEUER. Yes. Now, I have two more questions.

Yes, Sat Pau?

Mr. **Mittal**. I have a comment.

Mr. **Scheuer**. Briefly, because we still have the last panel, comprised of our one-man brain trust here.

Mr. **Mittal**. Just half a minute.

I will suggest that in a given situation, the donor country or the donor institution must press upon the recipient country to set apart a major portion of the food aid which is marketed there and the price of which is set apart for some kind of a national product. The focus must be that the major portion of the food aid must be devoted to social welfare, or rural welfare, or community welfare, rather than building bridges or hospitals or things like that which might otherwise be very, very important from their point of view, but it must be directed to immediate social and rural and community.

Mr. **Scheuer**. Literacy education, Claudine Schneider says. Maternal and child welfare programs.

Mr. **Mittal**. Why not?

Mr. **Scheuer**. Let me ask: Are the peoples of your own countries feeling the pressures of environmental deterioration today? Are they aware that there is a shortage of resources of food and land and water that is related to population growth? Are they aware of this phenomenon that UNICEF and Jim Grant have just identified? Are policymakers in your country aware of that phenomenon?

Mr. **Mittal**. Mr. Chairman, they are aware. But, regrettably, awareness has not been translated into action. Awareness is there.

Ms. **Schneider**. Could I just share one thought? One of the things that I think would be very helpful as we are one global community and all in this together, that often-times our policies might be structured in such a way where we think we are doing the best thing for you. But what do we know? I mean we can only try to come up with the most appropriate solutions.

But what I think is so important is for those recipient countries to not feel that you have no voice in what you receive. And I think that the process has to go both ways, so that the receiving nations can say, all right, you're going to assist us with energy technology. Your leaders know enough to, for example, look at nuclear power and say, well, that is going to require a great deal of capital expenditure at the outset, it's going to require highly- trained and very well-skilled employees, and it's also going to leave us with the problem of the wastes.

So your country could put in a special request and say, look, we want more hydrotechnology that is updated, or we want passive solar design, or we want energy efficiency, or we would prefer gas turbines that burn sugar cane, or whatever it might be.

But it just seems to me that it's almost as a custom we have in this country at Christmas time, we exchange gifts. And in my family we always want to make sure that we give the ones we love the best possible present. And so as a result, since we also don't always want to be surprised, we tell the person who is going to give us a gift, well, I'd really to have this or that.

I think that we have to be more communicative in our appropriate needs. I heard from many farmers in Africa, many women that were doing the agriculture say, "We don't really want to use all of these pesticides. I don't understand why your government sends us so many pesticides. Isn't there a better way?"

Well, there is a better way, but we're not giving it to the Africans, and we should be. But we have to have that consciousness raising on the part of the receiving nations, too.

Mr. KWIDINI. I don't know what the practice may be now, but certainly in my own country we prefer to define the projects and formulate the projects. We don't want it the other way around, in which the aid is tied to a particular project which the donors have in mind. We would rather go to the donors and say, this is our need and this is the project that we want to satisfy.

Mr. KEY. Yes. I think one of the problems here is that there's a whole layer of hidden subsidies in energy, and you can see this in both the developed and the developing world. For instance, it's tempting for a developing country to ask a donor nation to design, say, a power station or an energy system for their country.

So we might design an environmentally-sensitive energy system suitable for that country, but it's more expensive for the option which they can go buy from a third country anyway. That is one problem we have to help developing nations with.

I think there is another problem, that we really must come to the time when both consumers and producers in the developed world pay the full environmental cost of the energy or whatever they receive, because at the moment they are not there bearing the environmental cost.

And we can see that there are countries where the demand for electricity is almost infinite because the tariffs are set very low or because the charges are simply not collecting. And the results are unnecessary power stations, which are environmentally degrading.

Coming back to the first point, Congresswoman Schneider, there are, of course, no Nobel Prizes for the person who developed oral rehydration therapy, perhaps the biggest lifesaver of all. It's very unglamorous. It's grinding, hard work.

Mr. SCHEUER. All right. Now I want to ask the panel one last question before we go to our last panel and our last speaker.

We have heard from other witnesses at other hearings that African women really would like to control their fertility, and the difference between the 80 percent who are aware of it and the 30 or 35 percent who practice it is not made up of indifference. A lot of that gap is accounted for by the fact that they can't convince their men, their husbands, to permit them to control their fertility. And they say that the men are part of the problem, and they desperately want young men, young boys along with young girls in school, and young men along with young women just before or just after marriage to be educated as to the need for that family to control its fertility.

The Prime Minister of Tunisia, Muzali, he says to young men, "Don't measure your macho, your manhood by whether you have a new child every year. Measure your manhood by what you put into the child's head, the learning that you put into his head, the food that you put into his stomach, and the shoes that you put on his feet. If you are successful in those things, then you are truly an effective man."

African women apparently want help in educating young boys and then young men to understand the need for a young couple to control their fertility, understanding that if they work with their wives and help their wives, they will be dignifying the family, dignifying their wives and, above all, dignifying themselves.

Do any of you have any reaction to the need for young men in Africa to be educated in the need for rational steps in controlling population, both nationally and, even more important, in the family?

Mr. KWIDINI. Actually, you have defined the problem accurately. The problem lies with men, and this is being recognized more and more in many African countries. And because of that recognition, family planning services are no longer only for women, they are also for men in order to educate them to the needs of those services.

Mr. SCHEUER. Anybody else?

Mr. SOTOMARINO. Just one point. I am used to hearing in my country that we have not the least care on population growth because we have lots of regions and we can't develop our richness and our industrial potential.

Mr. SCHEUER. You hear that in Peru?

Mr. SOTOMARINO. All the time. So they are trying to persuade us that this is the reality. But our experience is being repeated. In these 27 years that I mentioned with six presidents, the population grew, but the economical development did not. So that came and is there.

That's why I don't want to accept any more arguments such as we make our economical development and afterward we take measures on population growth. So for me it is reversed. We first take care of our population growth, and after we will take care of our economical development.

Mr. KEY. I hesitate to intervene because I think the pro-Westerners must be careful not to be patronizing on issues of population. However, just as well-meaning liberal Western MPs and congressmen and congresswomen tend to parachute into developing countries and pronounce the future, so I think the family planning associations tend to be perceived anyway as organizations which parachute in crates of condoms, which of course is far from the truth. And it is absolutely right that men, and young men in particular are perhaps the key to this problem.

But, you see, family planning associations are not just about birth control. They can, as I said, reach parts of the economy where nobody else can reach. And I have seen for myself the work of family planning associations in, for instance, Nigeria and Gambia where they are involved in sophisticated problems like parasite control, or in other parts of the world they're involved in literacy campaigns. There are even parts of the world where the local FPAs are involved in banking.

Once the FPAs have gained credibility, they have actually shown the local communities that it is they, the individual mothers and fathers in the villages, who do have it in their power to change the future.

Mr. SCHEUER. Well, I quite agree with you that we have to be very sensitive, we Western parliamentarians, about being patronizing, creating the posture that we're delivering the word from God in his heaven.

I will say, to the credit of the Global Committee and Akio Matsumura, that we have worked to a maximum extent through local parliamentarians. We have a conference of parliamentarians in Africa, and Akio may make a tremendous contribution to organizing and I may be involved. Maybe I'll make a five-minute speech somewhere along the line. But it is African parliamentarians whom we quietly and privately mobilize who are at stage center in every aspect of the public operation of that conference.

So it is Africans conferring with Africans,and Africans counseling with Africans, and Africans giving their insights to other Africans that is the name of the game. It is the only way it can be done, and I think that's one of the remarkable contributions that the Global Committee has made, that we have played through Asian parliamentarians in Asia and African parliamentarians in Africa, and Latin American parliamentarians through the high talents and abilities of Hernan Sanjesus who is sitting here in the audience. We have pretty much followed that dictum, and I welcome your active involvement and leadership in the Global Committee, Robert Key, because I know you will validate that approach and support it and enlarge it.

I want to thank this panel for their wonderful testimony. It's been a great pleasure to listen to you, and I am very grateful for you to have made the effort of resources and time and energy to come and counsel with us.

We are now going to move to the last panel, our one-man brain trust, Fred Sai, the Population Advisor to the World Bank. I have a long description of Fred Sai's talents and accomplishments here.

He was a towering presence in the 1984 population conference in Mexico where he almost single-handedly brought order out of chaos and learning out of silliness so that that conference ended up being a very positive and constructive one.

Mr. MITTAL. Mr. Chairman, you are not asking us for the last word?

Mr. SCHEUER. No. Fred Sai is going to have the last word. He's going to be our cleanup hitter. You know, he's the fourth man at bat, he's the home run swat king.

Mr. MITTAL. Okay. Then in that case would you, for all of us, mention about our new venture of spiritual and parliamentary leaders and human survival?

Mr. SCHEUER. Why don't you do it? You make the announcement, Sat Pau. You make the announcement.

Mr. MITTAL. All I want to say is that the Global Committee took an initiative sometime back and the Temple of Understanding and the Global Committee, they organized a global conference of spiritual and parliamentary leaders in Oxford last year which brought together 100 parliamentarians in close contact with hundreds of spiritual leaders drawn from five major religions of the world, and a galaxy of parliamentarians and spiritual leaders of the eminence of His Holiness, Dali Imam, or the Archbishop of Canterbury, Cardinal Cooney, a whole lot of them. They were together and they discussed how best they can collaborate with each other, not only globally but at the national level, at the grass root level in trying to attempt to solve problems that confront mankind, including the problem of population.

So I wanted to mention the enormous interest that both these pillars of humanity have undertaken for fostering that kind of an understanding to work together for finding solutions to problems that confront this planet. I simply wanted to mention this so that you in the Congress and the Senate would also mobilize support for such a venture when even the USSR is opening up its doors for this kind of a conference and they are organizing their first national conference generally next year which President Gorbachev himself is inaugurating.

Mr. SCHEUER. And where will that be?

Mr. MITTAL. Yes, you will be invited.

Mr. SCHEUER. Yes. Where will it be?

Mr. MITTAL. In Moscow itself.

Mr. SCHEUER. Oh, in Moscow. Yes, I have been invited.

Mr. MITTAL. And, Congressman, it will be of interest to you to know that the Supreme Soviet, in collaboration with the Orthodox Church and the Soviet Academy of Sciences, are co-sponsoring this conference, which means they have recognized the need for bringing some kind of an understanding between these two pillars of humanity, the parliamentarians and the spiritual leaders, so that they can work hand in hand without any confrontation of any kind or acrimony, or without any kind of opposition from one to another in all fields that relate to welfare of humankind.

Thank you very much.

Mr. SCHEUER. Yes. I was in Oxford with you.

Mr. MITTAL. Yes, you were. And again it is Akio Matsumura who is the central figure.

Mr. SCHEUER. Of course. Akio Matsumura was the guiding genius behind that conference. It was one of the most marvelous and inspirational experiences of my life. I think all of us felt that way and they made at least one documentary film that's been shown on television all over the world, has been translated into many, many languages. So the word is getting out.

That was a tremendously important conference.

Mr. MITTAL. Thank you very much.

Mr. SCHEUER. Now let me thank you all and let's go to the last panel, Fred Sai. He is a graduate of the Harvard School of Public Health. He was Minister of Health in Ghana. He's worked with the Food and Agricultural Organization. He's worked with IPPF and various other non- governmental organizations and governments. And, as I said before, he did an absolutely spectacular job of chairing that Mexico City hearing and imposing some rationality, some discipline, to bring some order out of chaos.

He is one of the towering figures globally in the community of experts and government workers who are trying to lead us into a better day. We are delighted to have him here today as the home run hitter to take us to the mountain top and summarize what exists and then tell us about that city on the hill, where we're going.

Ms. SCHNEIDER. Mr. Chairman, might I apologize in advance because, Dr. Sai, I will not be able to remain to hear your testimony. However, my very able staff person will be here to take notes, and

I hope that each of you will please take a copy of my legislation before you leave and pick out whatever pieces you think are appropriate for your own use.

So thank you all very, very much. I have found the information that you have shared with us today exceedingly helpful and I, too, will take these pearls of wisdom and sprinkle them around my own community. Thank you very much.

Mr. SCHEUER. Fred Sai, please take five or 10 or 12 or 15 minutes and sum up for us, and then we probably will have a very few questions for you.

STATEMENT OF DR. FRED SAI, SENIOR POPULATION ADVISOR WORLD BANK

Dr. SAI. Thank you very much, Mr. Chairman. I like your mixed metaphor of my towering presence, all 5' 4".

I thank the committee for asking me to join in this informal statement. As you know, but for my change in position, I would have loved to have appeared at the proper hearing and would have loved to have produced a paper.

I wish, though, that I had been informed that I was the last speaker, because then perhaps I could have made more futuristic thoughts available on this. However, I will try.

I think one thing which is important at present is for us to realize that there are theories of population and development which claim to be scientifically based but whose bases in science are really rather thin. I am referring particularly to the theory today which maintains that population is neutral in the development equation; that given the level of development, the population will come down by itself.

I think what is more likely to be the true situation is that population has a two-way relationship with development; that development forces people to change their life styles and, with the changes in their life styles, their population growth and their settlement habits and so forth; but also that there are levels of population growth rate, there are ways of population settlement (distribution) which could be inimical to the development process itself.

And whilst I agree with Mr. Robert Key that much of the traditional Malthusian theory can be considered as debunked, truthfully, in that he couldn't have anticipated the extent to which technology would have changed life and living at the time he was making his postulate, there was one component which we have to bring into that postulate in which I am not sure that they weren't right, and that is human ingenuity, not to create new technologies, but to create new social, emotional, psychological and political institutions physical and intangible.

One such operates very much in the field in which we are involved at the present time, the field of population and food. There is no doubt that there is enough food in the world to feed every human being in the world adequately today. There is no doubt in my mind that the world will be able to keep feeding the growth of this population well into the first half of the next century, in theory.

But this is where you and I part company, sir. At the present time, I don't see that the way that the world is creating its institutions, even if it is coming together, the kind of strength and the thinking that goes there, that we are anywhere near the best effort.

Whilst we have global sufficiency of food, we still have national problems of food distribution inter-nations. Even where we have within-nation sufficiency of food like we have in India, we have got a major problem of food security for the people within the country. How do families get food and what sort of families are not getting the food, and how long will they be able to continue producing the food?

So there are all of those stresses. And none of these stresses is made easier by rapid population growth. Some of my scientific and academic friends have come to some terms with their situation and they want to make a postulate that we can say that in the population, food and environment equation, rapid population growth cannot be considered as one of the "ultimate causes," but it has to be considered as what they call a proximate cause. That should be good enough for us.

It is a proximate cause and in some countries, given today's reality as they live it, it is both a proximate cause and an ultimate cause. Why? Because types of agriculture that are possible in some countries today, as FAO pointed out in the carrying capacity study, you have countries already where the carrying capacity has been reached, given the types of agriculture that they can do today.

And even if you make provision for a low level of technological intervention, you have to allocate time and resources for those interventions to be brought into play and for them to yield results.

If you are unable to do that, then you have to assume that the countries, given the present growth of 3-1/2 percent, if you don't do anything about it, then you can't but be condemning them into increasing poverty. You can't but be condemning them into increasing degradation of their environment, because poverty, as we know, is a much more major degrader of the environment than the affluence of the Western world. Much of the affluence degradation of the environment is degradation which, with tough legislation, you can do something about.

But with what kind of tough legislation, ladies and gentleman, are you going to tell a poor person, "Don't go into that park and poach on that animal and eat it." There is no way in which you can do that. Therefore, poverty and the attack on poverty has to be looked upon as a major input into this whole equation.

You have heard people talk about deforestation. What causes a lot of the deforestation? Yes, I know about very beautiful plants, the mahoganies and so on. But on the margins, one of the major causes is the women who want to collect fuel wood, the women who want to make charcoal and sell it for a little cash, the women who want to collect forest fodder for the livestock and so on.

Now, those kinds of use of the forest become abuse of the forest to expert eyes. But to the hungry and to the poor, it is a legitimate use of the forest. What is the extent to which we can help to bring some hope and some substance into the system?

I submit that helping with relevant and appropriate technologies today is one of the inputs, but only one. But you cannot leave the population equation out of it because the major link here in our food and environment situation is something we touched upon almost in passing.

Women—woman—that is the major link in this, because in much of Africa the people who produce food crops are women. They are also the people who produce the family food. But they are the people who produce the children, too. Yes, they are assisted by men in that, but they produce the children. And the quality of the human capital that is available, therefore, for looking after that environment is disproportionately women quality.

And the health of women, the education of women, the way that women are taught to handle technology will be the major engine that will drive any issue that seeks to bring together population, the environment, and food—at least in Africa and to a large extent in Asia.

The World Bank learned some bitter lessons. Teaching men about growing trees in India failed. Not helping women to plant the trees in Kenya was not successful until they helped the women and taught the women to tend the trees. And we can go on and give very many examples.

Therefore, I personally feel that whilst we are involved in helping the Western world to look at its life styles so that the life styles become less polluting, the life styles become less avaricious—we don't say go back to 18th century living—but at the same time, the GNP need not be translated into so much of an encroachment on non-renewable resources, so much of a production of highly toxic waste that quite immorally you try to sneak into the back door and dispose of these toxic wastes in poor old Africa and in poor old Asia.

If you did that, if we were to tell the Africans, please, cut down your population growth rate, they will turn around and say, "So we leave the empty spaces for their garbage? We won't do it." It is about time, irrespective of what international agreements you make, to have some tough national laws.

If America can pass a law to say anybody who high-jacks or kills an American in a high-jack anywhere in the world, we'll get them, it is easy to say any American who disgraces America by putting toxic wastes in somebody else's country, we will put him up for trial because he is bringing our country to shame.

I believe that this is the kind of an example which gives you the moral stance from which you can begin to talk to other people about saving the environment, saving themselves from destruction.

I think the next is to be able to help the countries to evolve development policies that take care of their own people better than they have done in the past. We mentioned education today. To go into an African country as I did a couple of weeks ago, I found to my horror that only 20 per cent of their woman are educated and less than 40 percent of their girls, in 1989, I was ashamed of myself. I felt bad about it.

I just learned that there is going to be a world education conference organized by the World Bank, UNICEF, UNESCO, and I hope the U.S. Government will be there, up front, helping to bring its knowledge, expertise, and strength behind it, and to help us come forth—and this is not dictating—but with scientific evidence of what they will gain by emphasizing education for their women and for their girls to help convince the African governments that involving their womenfolk in the development process is an asset which will only yield good projects for them.

When we talk about development that takes care of the people, I think many of us understand it as development which has its roots where people live, so that we become part of the people, we become part of the solution, we don't sit like the cartoon, on top of the elephant, comfortable shaded and look at the people and say, "How are they faring there?" Or, when we eat, hoping something will drop down on them.

The participation of people in their own development is a sine qua non. If we are to do something to bring environmental resources, nondegenerating approaches, and fertility regulation into focus for communities, we must be out there.

And although it was said partly in jest, it was in 1960, I believe, that one of your presidents sent an aircraft load of scientists into Africa to go and talk with African scientists to try and find out what they would like to see done, what kind of interaction they would like to see grow. I think the time has come for a revisit with that particular thing, maybe with the specific objective of how goes the environment and how we can pull together.

Within the development programs for the area in which we are interested, a major one should be health, health which has been considered as a soft sector in the past. Without good health, your human capital hasn't got quality.

And again the women have their health jeopardized by too frequent fertility. We ought to make this a plank. Even for countries which say they don't want to see their populations controlled, if they want to see the population grow as a healthy population, family planning can help them, because a woman who produces a child every year, given the way in which our resources are available, is not likely to be a very healthy woman for a very long time. A woman who produces a child after her 35th birthday and already with five children, is unlikely to live very long.

It is for these simple reasons that our womenfolk have got 1 in 20 chances of dying in childbirth whilst yours have got 1 in 14,000 chances of dying in childbirth. And we want to make this clear and this knowledge available.

And within the good health policies and programs, one of the major areas should be population regulation, fertility regulation activity. Our governments need to be informed of the scientific fact that this is the one development approach which has got a major cost-benefit ratio. It has been proved over and over again, and the gains are gains which can be fed back into the economy.

I believe, Mr. Chairman, sir, that you have done a wonderful job of work. I don't know whether it comes out in the statements made so far, but I would like to state again that the major link between people, the environment, and their food is their women.

Thank you, sir.

Mr. SCHEUER. That was a very beautiful and inspirational statement. Fred Sai, you have lived up to your advance billing.

Would any member of the panel like to address a question to Fred Sai?

[Pause.]

I guess you feel the way I do. An afternoon of hearing has a rhythm all of its own, and I think when Fred Sai finished his piece, that was the rhythm for finishing this hearing. Fred, we thank you, all of us, for that marvelous message.

I want to thank the members of this panel, of this colloquium—as I mentioned before, it's not a hearing—for coming here, for giving us your wisdom, your insight, spending the energy and the time and your own resources to create this fine hearing record. We plan to use it very productively.

I may say just one thing in closing. We are going to get you the transcript as soon as we possibly can, two weeks. We urge you to get that transcript back to us with your corrections, your blue pencilings, so that we can go to final production of this report in a timely way, so that it will be of maximum utility to enlarge the understanding of all of the delegates to the Interparliamentary Union Conference next September in London.

May I say that Robert Key and Bruce Halliday and Sat Pau Mittal, Akio Matsumura, and many others in the Global Committee of Parliamentarians on Population and Development have been meeting informally, off the record, repeatedly, with top members, top leadership of the Interparliamentary Union. There was a time when there was not very good cooperation, when there was not very effective joint action between the Global Committee and the IPU, but I think that era has come to a close and I see a whole new era of warmth, of understanding, of mutual respect, and of far more effective collective action to preserve this global village of ours, the people, the environment, the biota, as a result of this improved relationship with the IPU.

I feel very happy that Bruce Halliday and Robert Key will be going to that IPU conference as members of their national IPU delegations. I hope to be there myself, along with Claude Pepper, and I think that's a good augury of things to come.

Once again, my thanks to you all. I repeat a last bouquet of thanks to Akio Matsumura, to Cecile, to Pudy, and my own wonderful congressional staff. I think we really accomplished something this afternoon and in these last two days of hearings.

Thank you very much.

[Whereupon, at 5:10 p.m. the meeting was adjourned.]

the green belt movement

a project founded by
the national council of women of kenya

NCW
KENYA

MOI AVENUE
P.O. BOX 67545
TEL. 24634
NAIROBI
KENYA.

14th February, 1989

James H. Scheuer
Member of Congress
U.S. House of Representatives
Committee on Science, Space,
and Technology
Suite 2321 Rayburn House Office Building
WASHINGTON, DC 20515
U. S. A.

Dear James H. Scheuer, Honourable Member of Congress,

Without planning to get myself over-stretched, it has become my major characteristic and a source of many a disappointment. Hence my inability to come in March and slow response. But here are some of my thoughts on the population and food equation (a quote from manuscript I am working on to appear in a booklet called, The Green Belt Movement: Sharing the Approach and the Experience:

" Food production in Africa has fallen repeatedly in the recent past. In some areas, famine is a recurrent phenomenon. Africans are constantly fighting hunger, and have been forced to import food.

Among the leading causes of poor crop yield is over-exploitation of land and loss of topsoil. Yet farmers have no choice but to continue to grow crops on highly impoverished soils.

To increase their crop yields, farmers need to improve the fertility or regenerative capacity of their soil with simple and inexpensive methods available to them. For example, they can fertilize with animal manure, mulch with agricultural residues (instead of burning them), use compost and apply agroforestry principles. (Agroforestry is a method that was used traditionally but has been ignored in favour of modern farming methods). The practice of planting, for example, nitrogen-fixing trees with crops enhances soil fertility, retains soil moisture and reduces erosion. Hence, crop yields increase.

Chemical fertilisers, pesticides, new seed varieties and huge irrigation schemes are some of the solutions being

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offered to Africam farmers. These solutions will not work. They won't work because: fertilisers and pesticides cost too much in foreign currency to be sustained.

- the other methods cost too much in local currency and will only be used by large farmers and mostly for cash crops while the subsistence farmers will continue to farm already impoverished soils and hasten desertification, and,
- they do not promote the regenerative capacity of the soil, that is, sustainable farming. So they don't offer any long-term solution.

Assuming that the current world order will not change overnight, African farmers have but one choice -- work with Nature to produce as much food as possible. As part of this, they should be reminded that there is wisdom in traditional farming practises.

The increasing amount of land used for cash crops is another factor that keeps Africa from producing enough food. In Central Kenya, for example, malnutrition is partly due to the fact that cash crops are replacing food crops.

Cash crops represent economic power. African farmers who do not earn foreign exchange through cash crops have a low status in their communities. Cash crops are an industry, food crops are not. The challenge is to convince farmers and leaders that farming for food, even for family consumption, is good economicS.

This is not to say that cash crops should be abandoned. Far from it. But considering the current world economic order, it is quite possible that people could over-exploit their resources in order to produce raw materials for export, only to earn too little to meet even their basic needs like food.

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People should be encouraged to grow their own food as much as possible.

Another reason for inadequate food production is the low priority given to africulture. Food production in Africa is a responsibility relegated to small farmers -- mostly women --who are not a priority for Africans. It is part of the "colonial heritage" that our universities and institutes are still producing white collar, laboratory-bound or office-contined decision-makers and extension workers.

A 1975-76 rural survey in Kenya showed that "research has failed to focus on food crops of women's agricultural efforts". The same report notes that "the lower level of education attainment of rural women partly accounts for the low female participation rates in activities other than farming". Thus, farming (other than farming of cash crops) is a job relegated to the uneducated -- those who are unemployable as white-collar workers. These are mostly rural women.

Agriculture for food production must become a priority for Africa if famine is to end. It has to become economically attractive to have well-trained farmers. Africans need to appreciate that while they are dying of hunger, some countries have too much food. And if they cannot find the funds to import this food, the only alternative to starvation is for Africans to produce their own food.

Food security can become a reality for Africa if Africans made agriculture a priority. Root crops and drought-resistant crops had always been Africa's hope for hard times. Coupled with improved food-processing and storage facilities, they could ease the burden of famine, But these crops are ignored by Africa's elite, and it is these people who sit in the Ministries of Agriculture and of Economic Planning and make decisions.

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Small farmers, particularly women farmers, should be supported if food production is to increase in Africa. Unfortunately, these are the farmers that are the most minimised. They are the farmers that are the most ignored and considered peripheral in national economics. And they have neither the political power nor the economic power needed to demand better compensation for their labour or to prevent subsidised food imports.

Ironically, while thy have been pushed to the periphery of the economy, they are central to food production. This must change if famine is to end.

We must prioritise and empower the small farmers. Then, perhaps, agriculture in Africa will attract educated, dedicated and resourceful Africans who will be willing to produce enough food to feed Africans.

If not, African elites will have to spend more foreign exchange purchasing arms to protect themselves and their interests. For when citizens become poor and hungry, they become politically unstable and difficult to govern. The enemy, then, rises from within and not from across borders. If current trends continue, political instabilities and military coups d'etat can only increase.

The need to address the population question:

It is important to understand the population issue and how it interrelates with under-development, poverty and environmental degradation.

At four per cent and rising, Kenya's population growth is among the highest in the world, It is a trend that can be seen throughout Africa. However, the more affluent are the ones who are concerned about the rapid increase in population. And they blame the poor for it. But why are there so many people?

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Some of the world's poverty is caused by injustices created by the current world economic order. To call upon the poor to improve their situation within the current economic order is unrealistic. Hence the call for a new economic order, especially by governments of the less industrialised world.

Rapid population growth has also to do with the rights of women. Some communities oppose any efforts by women to acquire basic human rights and freedom regarding population issues. They deny women the rights of self-determination and self-fulfillment. As long as this prevails, it will be difficult to control the population growth and realise sustainable development. Indeed, we will be even more entangled in viscious circles which cause regression, instability and even more widespread poverty.

This is because suppressed, poverty-stricken and hungry people do not plan their families and they are not concerned with environmental conservation, even though they are the first victims of environmental degradation. They do not take their destiny into their own hands.

Instead, they place all their hope in God. They seem to pray, "Since you are God, work miracles so that I may survive. Make it possible for me to satisfy my basic needs. They (the people) are not aware that they have not used all the wonderul talents and resources that they already have,. They are asking God to be a magician, a miracle worker.

Many Africans have abandoned their traditional concept of God and embrased a new and foreign concept as their cultures, traditions, values and virtues have become deliberately eroded and debased under the pretence that they are satanic and will keep them from God in Heaven, the new Jerusalem.

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And it is from this/new power that they expect magic. For if calamities like poverty, hunger and drought are perceived as natural and, therefore, acts pf God, Africans have every reason to doubt the power of their traditional God and expect miracles from the new (European) God who seems to protect them/Europeans) from such calamities.

But there is growing evidence (even among the Africans) that these calamities are not acts of God but of humans. If that is so, Africans have to examine where they, rather than God, went wrong. Having more children than one can take care of, being poor, preventing the earth from bearing fruit.....these and other adversities should not be blamed on God. They are the acts of men and women. And it is up to us to turn things around with or without the blessing of some leaders.

Time has shown that those who do not work with Mother Earth are punished or eliminated by Her. She blesses us only if we are wise and work with Her, if we learn to be Her custodians and to appreciate the symbiotic nature of all life forms on this planet earth."

I hope that this statement can adequately replace my presence. I am looking for a ticket to come to the U.S.A. in June to receive an award from my alma mater, the Benedictine College in Kansas. If I can be of any use please let me know.

With my very best wishes.

Yours sincerely,

WMMaathai
Prof. Wangari Maathai
Co-ordinator
THE GREEN BELT MOVEMENT.

c.c. Akio Matsumura.

WMM/lla.

TESTIMONY

OF

CARL WAHREN

AID MANAGEMENT DIVISION
ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT

SUBMITTED TO

THE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
NATURAL RESOURCES, AGRICULTURE RESEARCH
AND ENVIRONMENT SUBCOMMITTEE

FOOD AND POPULATION HEARING
MARCH 1989

Population and Development

The Burgeoning Billions

In 1900 the annual population increase was 13 million people. By 2000 it will be 90 million. Developed countries, which made up one-third of the world's population in 1950 now account for just under a quarter. And their share will have gone down to 20% by the year 2000 and 13% by 2100.

The populations of the developing countries grew between 1965 and 1970 at an unprecedented pace of over 2.5% per year, as rapidly declining death rates combined with persisting high birth rates. Since then, birth rates have begun to fall faster than death rates in most countries. Today the natural population increase in the South stands at 2.1%, which nonetheless implies a doubling in 33 years. Life expectancy at birth has increased to about 60 years on average.

It took until 1927 for the world population to reach 2 billion. In only 70 years, Third World countries will add some 4.8 billion to their populations to reach 6.6 billion by 2020 (Figure, p.7).

In a century of change, demographic developments have been spectacular. And projections to 2025 are even more striking.

The Mosaic of the South

Regional trends in the South are diverse indeed. East Asia now has an average birth rate of 20 per thousand, which is little higher than that in some developed countries, and an annual natural increase of 1.3%. Birth rates remain high in Africa and West Asia, where the annual population growth is about 2.9 and 2.7% respectively. It is about 2.2% in Latin America and Southern Asia, which have begun the transition to lower fertility.

Africa's prospects are alarming. The population has risen from 225 million in 1950 to 600 million in 1987. It is projected to reach 880 million by the end of the century and 1.6 billion by 2025. Now 45% of the African population is under 15 years of age. In several East African countries, annual rates of increase are 3.5% or more, implying a population doubling time of 20 years or less.

Latin America has seen a considerable decline in birth rates from a peak of around 42 per thousand in the early 1950s to the present figure of 29 per thousand. Nevertheless, the present population of 425 million is projected to reach 540 million by the year 2000 and 780 million by 2025. Life-expectancy at birth is now 66 years and infant mortality is relatively low, at 58 per thousand live births. Some of the poorer countries (Bolivia, Guatemala, Haiti) do have high birth rates, high infant mortality and relatively low life expectancy. ▶▶

Carl Wahren is Head of the Aid Management Division of the OECD Development and Co-operation Directorate. He was a member of the Drafting Group of the World Population Plan of Action at the Bucharest conference in 1974 and of the Drafting Committee of the Mexico City Declaration of 1984.

Gérard Rancinan/Sygma

Southern Asia will be the most heavily populated region for some decades. Its present population of 1.14 billion (815 million in India) will increase to some 1.5 billion by the year 2000 and reach nearly 2 billion 20 years later (1.3 billion in India). In Bangladesh, which is already more than twice as densely populated as, say, Belgium, the present population of 105 million is projected to double by 2020. And what will then be the consequences of 'natural' disasters such as this autumn's flood?

In East and South-East Asia birth rates have declined significantly. East Asia halved its rate of population growth between the late 1960s and early 1980s. But the young age-composition of both sub-regions means that considerable growth continues.

Most Arab countries have seen little or no lowering of birth rates, whereas crude death rates are relatively low.

THE DEVELOPMENT OF THINKING ON DEVELOPMENT

For years, Third World development was discussed and planned with little or no reference to demographic factors. Census work and vital registration was regarded as a luxury in many poor countries, and donor agencies seemed to concur. As a result little was known about the size and composition of the populations that were supposedly the beneficiaries of development. Attitudes to family size and child-bearing were equally poorly understood.

Many donor and most recipient nations seemed convinced that rapid population increase would facilitate development. Large populations would provide domestic markets and were considered a prerequisite for economies of scale. It was assumed, too, that, regardless of their socio-economic conditions, people wanted many children. In any case, the topic of family planning was considered highly sensitive and few governments were ready to raise it. It was left to non-governmental organisations, notably women's groups, to worry about the rapidly growing number of illegal abortions and to interpret their implications in health, attitudes and costs.

India was an early exception. Prime Minister Jarwaharlal Nehru introduced family planning as official government policy in the early 1960s. He emphasised that family planning was no panacea; alone it would not solve India's development problems–but without successful family planning India would never manage her transition into a modern society.

The 1974 World Population Conference in Bucharest constituted the first recognition by the world community that population factors are truly cross-cutting: people, their numbers, needs and aspirations will decide what direction development will take. The Bucharest conference reconfirmed Mr Nehru's wise observation that successful development requires well co-ordinated action in which family planning forms an integral part. The World Population Plan of Action, formulated at the conference and subscribed to by nearly 140 national governments, states that 'All couples and individuals have the basic right to decide freely and responsibly the number and spacing of their children and to have the information, education and means to do so; the responsibility of couples and individuals in the exercise of this right takes into account the needs of their living and future children, and their responsibilities towards the community'.

Progress since the Bucharest Conference has been remarkable. Ignorance and unfounded assumptions have been replaced by encouraging experience. In 1984, the International Conference on Population in Mexico City concluded that population and development policies reinforce each other when they are responsive to individual, family and community needs. Family planning programmes have been successful in meeting demand and reducing fertility at relatively low cost.

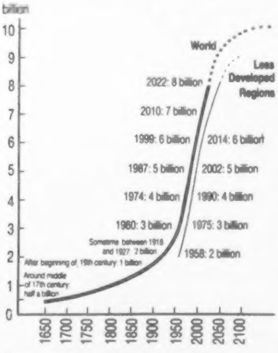
Nonetheless, differences in life expectancy, fertility, mortality and morbidity between developed and developing countries remain striking. And the World Health Organisation (WHO) has suggested that about 300 million couples who do not want more children are not using any method of birth control. If these people could be reached and assisted, developing countries could avoid the aggravation of such problems as maternal and child mortality, overpopulation, unemployment, food shortages and environmental degradation.

When considering the population increase in the South, it should be remembered that today's industrialised countries never experienced anything of that order in their histories. At their peak, during the last century, growth rates in Europe rarely exceeded 1.5%. Thus a country like Kenya is now increasing its population almost three times as fast as did European nations at their historical swiftest. Even in North America, the maximum demographic growth rate, boosted by immigration, was only 2% a year, with massive land and natural resources to support it.

Statistical Caveats

These figures for the future are only projections and therefore contain considerable degrees of uncertainty. Yet past projections by the United Nations have turned out to be remarkably accurate. And although the estimates stop at 2025, in no way does that imply that populations will necessarily be levelling off by then.

Figure
GROWTH OF WORLD POPULATION



Note: The graph does not necessarily depict what will happen in the future. It illustrates only what could happen under certain assumptions of fertility and mortality. Curves have been manually extrapolated beyond 2025.

Source: *The State of the World Population 1988*, United Nations Population Fund (UNFPA), 1988.

Depending on the age composition of their populations, and in the absence of shared social and economic progress, including well-functioning family planning programmes, many of the least-developed countries could theoretically go on adding considerably to their populations during most of the next century. But it is impossible to foresee at present what will be happening by then. There is only scant knowledge today about the carrying capacity of current support-systems, including possible ecological breakdown points. Can the gains in life-expectancy after World War II continue indefinitely, everywhere?

The UN has also produced longer-term projections suggesting that the world population might stabilise itself at around 10 billion in the next century. This projection rests on the assumption that women worldwide will bear, on average, about two children each by 2035.

If that date holds true in Africa, for example, the population would stabilise itself at around 1.4 billion during the next century (the UN medium projection). But this assumption seems unlikely. If the two-child average is delayed until 2065, Africa's population would then stabilise itself at 4.4 billion towards the end of next century (the UN high projection). With similar variations in assumptions for the world as a whole, global peak figures vary between 7 and 14 billion in the course of the next century.

The Impact of AIDS

Demographers argue about the potential impact of AIDS on mortality rates in the worst-affected countries. Today it seems that, at least initially, AIDS will be felt more because of where it makes its impact in society rather than through the sheer number of deaths: in certain countries, middle-class, urban groups who are very important for development may be hit hard. Nonetheless, as in the industrialised countries, some under-privileged minority groups are also highly vulnerable.[1] Infant mortality will increase substantially in some areas. Yet it seems improbable, at least at the moment, that AIDS will significantly alter the overall population developments that have been predicted. ■

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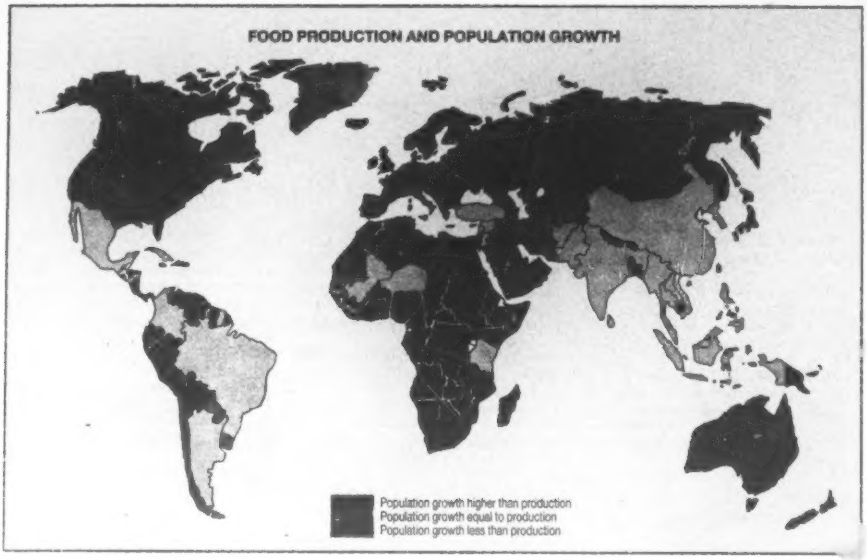
[1] Carl Wahren, 'Can AIDS be Contained?' The OECD Observer, No. 154, October/November 1988.


FOOD PRODUCTION AND POPULATION GROWTH

Population growth higher than production
Population growth equal to production
Population growth less than production

Source Marie Stopes International

The Impact of Population Growth

Many Third World populations have been rising faster than agricultural output (map). In about 70 countries, food production per head of population has declined since the 1970s.

Food Falls Behind

Except for Asia, developing countries have had to import an increasing part of their food requirements. An annual cereal deficit of 10 million tonnes in the mid-1960s rose to 33 million in 1975–79, and on present trends, could reach 132 million tonnes by the year 2000.

> *Every aspect of economic, social and political life in the developing countries will be affected by population growth.*

The World Bank has estimated that some 800 million people now lack enough food to maintain an active working life; that is, they survive on below 90% of the minimum requirements that have been defined by the Food and Agriculture Organisation (FAO) and World Health Organisation (WHO). The number of people running serious health risks because of calorie deficiency reached some 340 million in 1980.

Malnutrition hits countries with adequate food supplies, and not just the poorest. There are several explanations: marked social inequalities, very low purchasing power for some categories of the population, problems of storage and transport. Although the number of malnourished people has declined in the past two decades as a proportion of the world's total, in absolute terms it has risen.

Arable land area is unlikely to increase by more than 5% between now and the year 2000. So most of the extra food required will have to come from higher yields. But these in the main depend heavily on water, oil and fertilisers. And the long-term environmental implications of modern farming techniques are disquieting, particularly in parts of Africa.

There is an alternative food source. Fish is particularly rich in protein and for over half the population of the Third World it provides at least 40% of its protein requirements. But because of over-fishing by industrialised countries and marine pollution, there is little prospect of raising the natural productivity of world fisheries. Aquaculture, coupled with the exploitation of hitherto undeveloped forms of marine life, such as krill, may help bridge the protein gap, but such developments are uncertain, and much depends on the state of the marine environment.[1] Developing countries experience enormous difficulties in safeguarding their fish stocks, and damage to that particular resource is less visible and thus usually arouses less public concern than, say, deforestation.

Pressure on the Environment

Population pressures overload the capacities of the environment in many developing countries. The momentum of population growth combined with widespread poverty creates serious imbalances between population sizes and the ecosystem.

Some 95% of projected increase in the world's population from 5 billion of today to over 6 billion by the year 2000 will take place in developing regions, which are often environmentally fragile. This imbalance will aggravate the problems of poverty and increase the number of 'environmental refugees'. During the 1970s twice as many people suffered from 'natural' disasters as in the 1960s, in particular from floods and droughts caused by neglect of the environmental fundamentals. The trends foreseen for the 1990s are no brighter.

Baldev/Sygma

The number of victims of 'natural' disasters (such as last September's floods in Bangladesh) doubled recently—within a decade.

Water Supplies Running Dry?

Obviously, population pressures lead to the increased consumption of natural resources. Drinking water is already becoming scarce. Rivers, lakes and oceans are being polluted. Countries in desert regions buy themselves varying periods of grace by pumping ground-water out of subterranean pockets. Hydrologists are worried that several countries, particularly in sub-Saharan Africa, may rapidly be approaching acute water shortages. This will not only threaten their growing populations but will undermine their attempts to industrialise and modernise their agriculture.

Rapidly growing food and energy requirements caused by high population growth aggravate the alarming trends of desertification and deforestation. Tropical soils are often sensitive to erosion. Over-grazing by expanding livestock herds and over-cultivation make them more vulnerable still.

▸▸

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[1] See Carl-Christian Schmidt, 'The Fishy Business of Aquaculture', **The OECD Observer**, No. 154, October/November 1988.

According to one UN report, nearly one-third of all land is at risk of turning into desert, and topsoil is being lost at the rate of 26 billion tons a year (UNFPA).

Short-term Difficulties v. Long-term Stability

Because so many developing countries are in serious economic difficulties, they seize short-term opportunities to export raw materials and industrial products for foreign exchange; these activities often conflict with longer-term ecological considerations.

Deforestation, for example, has several causes. One is the expanding population of nomadic cultivators, who often systematically cull the wood around their base camps or villages. Another is cutting for firewood–the main source of energy for roughly one in four of humankind. Other causes are commercial logging for export to the North and clearance for cattle-grazing. The world's forests are presently disappearing at an estimated rate of 11 to 18 million hectares a year. The rate of tree plantation in the tropics amounts to less than one-tenth of the rate of deforestation. It has been calculated that up to 3 billion people could live in areas short of fuelwood by the year 2000.

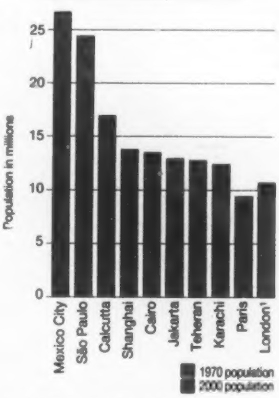
If tropical forests continue to be cleared at the current rate, an estimated 10 to 20% of the earth's plant and animal life will be lost by the year 2000. One can only speculate as to the full implications for the planet's gene bank, the climate, the production of oxygen, and so on.

Jobs and the Lure of the City

Unemployment and under-employment is already estimated to be running at 40–50% in the South. The International Labour Organisation (ILO) projects an increase of 1.4 billion workers in the developing regions between 1985 and 2025; some 800 million in Asia, 430 million in Africa and 170 million in Latin America. The majority of countries concerned find it increasingly difficult to create new jobs to absorb their constantly expanding work-force. Extraordinary additional investments will be required to prevent unemployment expanding dramatically.

Some 30 years ago the migration of millions of unemployed people from the countryside to the cities began on a massive scale. If developing countries double their population every 25 to 35 years, their major cities will often do so in 10 to 15 years, some 60% of that growth being due to natural increase. In 1970, only 13% of the urban population of developing countries lived in cities of over 4 million inhabitants; by 2025, 28% will do so. Since unemployment rates are often twice as high in the cities as in the countryside, the social consequences of the population explosion are disquieting. City populations will grow especially fast in Africa, by something like 440% between 1985 and 2025 (Figure 1).

Figure 1
THE MEGACITIES, 1970-2000



1. London's population will have fallen during this period.

Source: United Nations.

A quarter of the world's families live in makeshift shelters. Fully half of the Third World's urban dwellers live in shanty towns which double in population every seven to ten years.

A report just published by the World Health Organisation (WHO) and United Nations Environment Programme (UNEP) has been widely quoted as stating that the air breathed by many of the world's city-dwellers is not fit for humans. Urbanisation and high birth rates have also overtaxed water supplies and sewage systems. What will the situation look like in 2025 when the world will have some 135 cities with populations of over four million, most of them in developing countries?

The Task for Education

Thanks to massive investments in education, the numbers of children enrolled in primary and secondary schools more than quadrupled be-

Almost a third of the total land area of the planet faces

tween 1960 and 1985 (from 144 to 640 million). School enrolment ratios in African primary schools increased considerably, from 44% to over 80% between 1960 and 1985.

The proportion of illiterate adults in developing countries fell from 59% in 1960 to 38% in 1985. But because of population growth the total number of illiterates will rise from 720 million in 1970 to 880 million in 1990 and 950 million by the turn of the century.

The task facing education systems is daunting, in quantity and quality. The number of children aged 6-17 is projected to rise from 940 million in 1980 to 1.28 billion by the year 2000, an increase of 340 million. Africa will face the hardest task. According to UNESCO, the number of children enrolled in primary schools will have increased from 96 million in 1990 to 135 million by the year 2000.

Women Bear the Brunt

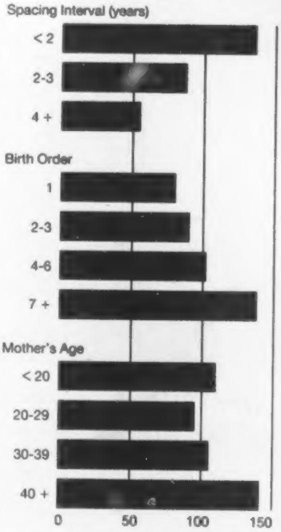
In all developing regions, lowered rates of population increase would free resources to improve the quantity and quality of education and reduce female illiteracy substantially. Indications are that the number of female illiterates will increase much faster than the number of male illiterates—the respective rates of increase were between 1960 and 1980 some 74 million and 20 million. In 1985 the female illiteracy rate, at 49% of adult women, was almost twice the male rate of 28%.

These percentages are not unrelated to the rapid population increase, for which women have borne the heaviest costs, both through the extra work load and the health risks connected with pregnancies and births that are too many, too frequent, too early and too late (Figure 2). Between 35 and 50 million abortions are thought to be carried out annually on women desperate not to go through with their latest pregnancy. Some half a million women die every year from conditions arising from pregnancy or child birth. The morbidity toll is unknown. It has been estimated that extended family planning services could save 200,000 women each year. It would also help reduce infant mortality.

the threat of desertification.

Alain Nogues/Sygma

Figure 2
TOO MANY, TOO SOON, TOO CLOSE, TOO LATE
Infant Mortality per 1,000 Live Births, Peru



Source: Shea Oscar Rutstein, 'Infant and Child Mortality: Levels, Trends, and Demography Differentials', Comparative Study No. 24, World Fertility Survey, London, 1982.

Charlotte Thege

The cutting of fuelwood provides almost a quarter of humankind with its principal source of energy—but is one of the main causes of deforestation.

But family planning on its own will not be enough. In the words of UNFPA, 'Women in most developing countries still derive their status in their community from their positions as wives and mothers. An important contribution to lower fertility will therefore be change in the way women derive their status. Contributing to a change are the legal right to own and inherit property, the right to vote, the right to choice in marriage and divorce, education, acknowledged life options other than childbearing—and, of course, access to family planning information and services'.[2] Needless to add, these are desirable changes in their own right, regardless of their impact on fertility. ■

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[2] *1987 Report*, UNFPA, New York, 1988, p. 14.

J. Van Acker/FAO

Several Latin America countries have obtained spectacular drops in birth rates thanks to effective family planning programmes–not least Brazil, Colombia and Mexico.

Family Planning Costs and Benefits

Today only very few governments in developing countries are opposed to family planning. Official family planning programmes have grown considerably during the 1980s. The more successful have achieved spectacular declines in birth rates–Barbados, China, Cuba, Hong Kong, Indonesia, Korea, Mexico, Singapore, Sri Lanka, Taiwan, Thailand. In Brazil and Colombia, NGO programmes have had similar success.

China's population today would probably have been some 110 million larger without the population policy of her government, including a vigorous family planning programme. A similar estimate for India suggests about 80 million extra births.

According to the latest available data, over half the world's couples living together, where the woman is of child-bearing age, are using contraception. In the South an estimated 45% do so–with wide variations from one continent to another (Figure).

Can too fast a population increase be curbed by family planning programmes? Or is 'development the best pill'? A constant point of argument in the 1960s and '70s, the question was finally settled at the International Conference on Population in Mexico City in 1984 where the world community agreed that family planning and economic development were not alternatives but complementary necessities.

Channels for Contraception

Recent research indicates that, given certain conditions, support for family planning programmes can be more effective in reducing fertility than support for other development programmes–which does not mean, of course, that such other investments are not highly desirable in themselves. The few studies so far undertaken in the Third World reveal that between 30 and 50% of the drop in fertility can be ascribed to family planning programmes. And that proportion should grow in the future.

Ideally, family planning information and services ought to be integrated in the broad range of social services. But where health infrastructures are poor or non-existent, family planning information and certain contraceptives can be provided through community groups, particularly women's organisations, traditional health systems and commercial channels. In some countries family planning has been an agent of social change and a forerunner o expanded primary health services, particularly maternal and child health.

> "This Report shows that economic and social progress helps slow population growth, but it also emphasizes that rapid population growth hampers economic development. It is therefore imperative that governments act simultaneously on both fronts. For the poorest countries, development may not be possible at all unless slower population growth can be achieved soon, even before higher real incomes would bring down fertility spontaneously."
>
> "Analysis of fertility decline shows that two policies critical to reducing fertility, family planning and female education, complement each other. Between 1972 and 1982 family-planning programs have had minimal effect where female education is low, in part because it is difficult to operate such programs without some educated women to staff them, and in part because of lack of demand for contraception. Equally, female education has had minimal effect where family planning services have been unavailable. The effect of the two together, however, has been powerful."
>
> "Where family planning services are widespread and affordable, fertility has declined more rapidly than social and economic progress alone would predict. Examples include Tunisia, India, Thailand, Colombia, Costa Rica, and more recently Indonesia and Mexico."
>
> Summary, World Development Report 1984, Washington DC, 1984.

But men have a part to play too. Research from different cultures has found that male opposition is a major hindrance to a wider acceptance of, and investment in, family planning. So now husbands, too, are being informed about the benefits of birth control.

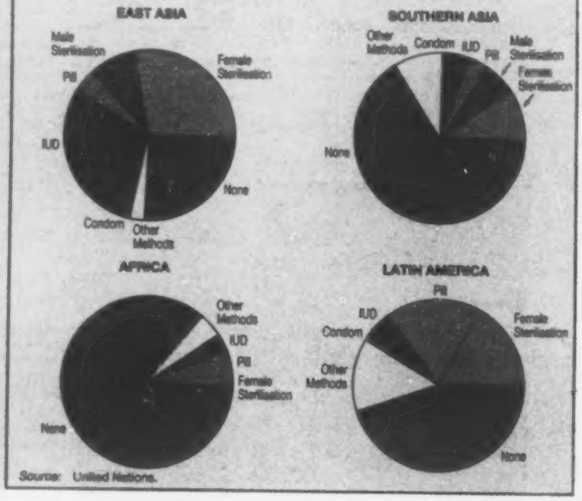
Unmet Demand for Family Planning

Having an established national policy is one thing. Implementing it is quite another. Many governments do not have the necessary resources in manpower and money. In addition, notwithstanding a marked and fairly widespread shift in opinion, several governments lack the political will to support activities they feel might upset ethnic, religious or political sensibilities. As a result, millions of people still lack access to safe and effective contraceptive services.

Many more people want to plan their families than do at present. The World Fertility Survey, conducted by the International Statistical Institute in The Hague, has indicated that, except in certain African countries, there is a large unmet demand. One significant point is that half the women who said they wanted no more children were not using any method of contraception. And a recent analysis covering 18 developing countries shows that if those women who stated that their last birth was unwanted had had the means to prevent it, the natural population increase in those sample countries would on average have been only 1.3% instead of 2.2%. ▸▸

Figure

FAMILY PLANNING BY REGION AND METHOD



Source: United Nations.

IPPF Helen Kitchen

Without its policy on population China would probably have some 110 million more inhabitants today.

The Modest Costs of Birth Control

In the past, foreign assistance paid for some 80% of total investment in population/family planning programmes in the developing world, and national governments paid only 20%. Today the ratio has been more or less reversed. Yet despite this significant increase in the commitment of the Third World countries themselves, in most of them family planning still accounts for less than 0.5% of national budgets. Less than 2% of official development assistance (ODA) is spent on population and family planning.

The World Bank has estimated that to achieve the extent of contraceptive use necessary for further improvement in women's health and for a more rapid decline in population growth, total family planning expenditures in the developing world would have to reach more than US$7 billion (in 1980 US$) annually by the year 2000. This is roughly four times current domestic and foreign expenditure.

> [illegible]

□□

The countries which have been most successful in lowering national birth rates have many features in common. They have given high priority to the development of human resources. They have invested in social services, including health and education, paying special attention to the status of women, female employment and improving maternal and child health care. They have given strong support to family planning information as well as to contraceptive services. Many of these countries have explicitly tried to provide for growth with equity.

It will be no easy task to provide some 1.3 billion couples and individuals with sustainable family planning services by the year 2000. But the last 15 years have brought a wealth of promising experience. Community participation, decentralisation and training are key elements in successful family planning. Governments, donor agencies and NGOS thus have a good base on which to plan for the 1990s. ■

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* Out of print, available on microfiche

United States
Department of
Agriculture

Economic
Research
Service

Washington, D.C.
20005-4788

April 26, 1989

Honorable James H. Scheurer
Chairman, Subcommittee on Natural Resources
Agriculture Research and Environment
House Annex 2, Room 388
Washington, D.C. 20515

Dear Congressman Scheurer:

Your April 14 letter asked for my insights on the following three issues raised during review of the testimonies presented in the hearing series on Population and Sustainable Food Production.

Question 1: Discussion of increased food production included the success of the green revolution and finding ways to extend the principles involved to other regions. Please comment on the environmental problems associated with the green revolution. To what extent are these techniques responsible for land degradation and other problems? How does this ultimately impact food production?

Answer: Land degradation is more a result of population pressures than green revolution technology. The production techniques associated with the green revolution are more likely to be used on better quality land than on the marginal lands where degradation is occurring. There are a few deleterious indirect effects, however. Occasionally, poor control of irrigation water in delta areas has led to salinization of soils. Also, improper use of fertilizers and pesticides may have caused some contamination of ground water. However, the green revolution significantly increased productivity. The resulting increase in food production has reduced the need to cultivate marginal land. On balance, there has probably been less land degradation because of the green revolution.

Question 2: Very little of the discussion in the hearings touched upon the potential effect of global climate change on food production. Is the agricultural research agenda adequately responding to the problems that may be presented by this phenomena?

Answer: Short-term and long-term relationships between weather changes and crop yields and productivity depend on the complex nature of climate change. For given changes in temperature, CO_2 levels, and precipitation, crop yields would be affected differently depending on geographic location, availability of water for irrigation, and crop type. Furthermore, future projected changes in climate are not known with certainty. In addition, projections at the regional and local levels are only approximate. The changes in climate being discussed by atmospheric scientists could be unlike those that have been experienced since the onset of modern agriculture.

Information on climate predictions and yield responses is being collected as it becomes available. We are also collecting information on potential adjustments by farmers that would affect changes in climate. As part of this effort, we are reviewing recent advances in biotechnology, such as drought resistant crop varieties.

Question 3: In many countries, arable land is being lost as urban areas expand. Are there any statistics regarding the amount of food production lost as a result of this trend?

Answer: The best source of international land use data is compiled by the Food and Agricultural Office of the United Nations (FAO). However, urban area is not a distinct category in the FAO data base. Urban is included in a category called "other land," which also includes forests and deserts. Although "other land" has increased over time, we can not be sure that all of the increase was in urban land and due to reductions in arable land.

Sincerely,

Ron Trostle/am

RONALD G. TROSTLE, Chief
Commodity and Trade
Analysis Branch
Commodity Economics Division

APR-24-89 MON 13:38 NAT'L AUDUBON/ P.02

National Audubon Society

NATIONAL CAPITAL OFFICE 801 PENNSYLVANIA AVENUE, S.E. WASHINGTON, D.C. 20003 (202) 547-9009

24 April, 1989

The Honorable James H. Scheuer, Chairman
Subcommitttee on Natural Resources, Agriculture
Research and the Environment
Science and Technology Committee
2321 Rayburn House Office Building
Washington, D.C. 20515

Dear Congressman Scheuer:

Thank you for the opportunity to respond to your question regarding global climate change and the potential effects on food production.

The National Audubon Society has identified stability and resiliency as essential in our food production systems if they are to be able to respond to the challenges of climate change. The potential threat to agricultural food production of a 3-8 degree F average temperature increase would come primarily from the extremes of drought, extraordinary heat waves, pest outbursts, and weed infestations predicted to be more common in a warmer world.

Key ingredients to stability and resiliency are diversity, protection of the resource base, and flexibility. Just as genetic variability is important for animals and plants to be able to adapt to changing environmental conditions, diversity within an agricultural ecosystem is also important. Inter-cropping, heterogeneous/resistant crops, biological controls, wind breaks, filter strips and integrated pest management are some methods that enhance the diversity of a managed ecosystem and give it stability.

Protecting the resource base requires adopting conservation practices that protect soil and water resources on agricultural land. Conservation practices like contour plowing, mulching, crop rotation and cover crops help maintain these resources and make crops more tolerant against various environmental diseases. Finally, flexibility in farming programs is also crucial for farmers to be able to adjust their crops in response to climate changes.

The agricultural research agenda is not adequately addressing these agricultural practices, which are beneficial for many reasons, including their role in addressing the problem of climate change. The agricultural research community could also do a better job in coordinating its work with other agencies.

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According to the US Department of Agriculture 1990 Budget Summary, global climate change is one of their three major initiatives, but their funding request for projects in this new program increased only $4.5 million over the previous year. This does not reflect priority funding. There are many opportunities for the domestic agencies concerned with global change to work together. The Departments of Agriculture, Commerce, Energy, and Interior, and Environmental Protection Agency, National Areonautics and Space Administration and the National Science Foundaton could work with USDA to develop and implement conservation practices that maintain soil and water resources and enhance the diversity of managed ecosystems. Pooling the knowledge base from these agencies would benefit us all as we address the uncertainties of the future.

We urge your Committee to support increased research effort in sound environmental practices in agricultural systems both domestically and abroad. This will translate into a more stable agricultural ecosystem, which will be better able to tolerate extremes in a warmer world.

A major symposium on global climate change is to be held at the National theatre (to hold 1,600 attendees) on May 5-7, 1989 sponsored by the National Academy of Sciences, Sigma Psi, the Smithsonian. No doubt recommendations will come from that body, that may be of interest to the Committee.

For more information on global climate change and the impact on agricultural production: Paul and Ann Ehrlich and Gretchen Daly are looking at global warming models and projecting the tolerance of drought frequency on global food production; Dan Dudek at the Environmental Defense Fund has done several studies on the impact of climate change on agriculture; and Lester Brown at the World Watch Institute has looked in detail at the general implications of global climate change. For information of agricultural conservation practices contact Maureen Hinkle at this office, or Roland Bunch at World Neighbors regarding conservation practices in developing countries.

Again, thank you for the opportunity to comment. If you have any questions, please do not hesitate to contact me or my assistant, Ken Snyder.

Sincerely,

Frances Spivy-Weber

Frances Spivy-Weber
Director, International Program

0800H

NATIONAL RESEARCH COUNCIL
2101 Constitution Avenue Washington, D.C. 20418

BOARD ON AGRICULTURE

TELEPHONE
(202) 334-3062

April 18, 1989

The Honorable James H. Scheuer
Chairman, Subcommittee on Natural
Resources, Agriculture Research
and Environment
Committee on Science, Space,
and Technology
2321 Rayburn House Office Building
Washington, DC 20515

Dear Mr. Chairman:

I am glad to hear your report on world food population is moving ahead. I have only a few comments to add in response to the questions in your April 14 letter.

1. The fertility and pest control technologies of the green revolution made it possible to apply western, chemical intensive production methods in traditional agricultural systems. These techniques have probably not degraded the land irreparably, but surely have had serious economic and environmental consequences in some areas.

2. The agricultural research agenda will be adequate to respond to global warming if basic plant and cropping systems research receives renewed emphasis, as called for in our forthcoming research initiative.

3. To a considerable degree, subject to economic constraints.

4. Yes -- it is a major problem. I do not know if new irrigation projects are designed more thoughtfully.

5. Not to my knowledge.

Best of luck in your continuing activities in this area. The Board would welcome a chance to get more heavily involved if a chance arises. These issues, however, appear not to be very high on the USDA's agenda these days.

Sincerely,

Chuck Benbrook
Charles M. Benbrook
Executive Director

The National Research Council is the principal operating agency of the National Academy of Sciences and the National Academy of Engineering to serve government and other organizations

ROBERT F. CHANDLER, JR.
421 E. MINNEHAHA AVENUE
CLERMONT, FLORIDA 32711
TELEPHONE 904-394-6861

April 20, 1989

The Hon. James H. Scheuer
Chairman
Subcommittee on Natural Resources,
Agriculture Research and Environment
Room 388
House Annex 2
Washington, DC 20515

Dear Congressman Scheuer:

Your letter of April 14th arrived as we were preparing to leave Florida for Maine where we spend the summer months. I shall attempt to answer your questions to the best of my ability. The numbers of my replies agree with the numbers of the questions in your letter.

1. When water supplies are adequate, usually from irrigation, the principles which led to the Green Revolution can be extended to any of the tropical and subtropical regions of the world. For example, in Senegal, where water from the Senegal River is available for irrigation, rice yields were the same as in the Punjab of India (from 6 to 8 tons/hectare with fertilizer added, of course).

As to land degradation, the high yielding varieties naturally remove more soil nutrients simply because yields are higher than those of the traditional varieties. However, the nutrients removed can be restored by the use of fertilizer. On IRRI's experimental farm, and at a number of sites elsewhere, three crops of rice have been grown annually for over 25 years and yields of 5 to 8 tons per crop are still being obtained. It is important to realize that the use of fertilizer in the less-developed countries of Asia and Latin America has increased from 5 to 10 percent yearly since the start of the Green Revolution. This would not have occurred unless it were profitable. In my view, we shall be unable to feed the world without a greatly expanded use of chemical as well as organic fertilizer and without extending the area under irrigation not only for rice but for other crops as well.

I am aware of the fact that some authorities on development maintain that the poor farmer in the less-developed countries cannot afford chemical fertilizer and the expense of irrigation. They contend that such farmers should continue to use the lower-yielding crop varieties and depend upon natural sources of organic materials to maintain soil fertility. I agree that we should do all we can to develop systems of management that will use crop residues and animal manures as substitutes for chemical fertilizer. However, experience in over-populated countries such as China, for example, has shown that using organic wastes alone is not sufficient to maintain high yields of cereal grains. As I am sure you know, in the mid-1970s China built about 14 large chemical fertilizer plants and China has been for centuries the largest user of recirculated organic wastes.

As we all know, the Green Revolution has had little impact as yet in sub-Sahara Africa. There are many reasons for this. One is that the sandy soils and hilly topography of much of central Africa is not condusive to high yields. In many locations the land cannot be irrigated and when the land is cleared of forests (in the more humid regions) soil erosion is severe. For some time to come the principles that led to the Green revolution in rice and wheat in Asia will not be useful in Africa. However, Africa does have unused water resources that must be developed. Its population rate increase demands this.

2. Much is being written today about the so-called Greenhouse Effect, that the trapping of heat by the increased content of carbon dioxide and other gases in the atmosphere will cause a warming effect so severe that we shall not only have drought in our grain-growing regions but flooding of low-lying coastal cities from the melting of ice in the polar regions. Unfortunately, I am no expert on this subject. My only comment is that I feel that the danger may be over-exaggerated. Carbon dioxide is leached from the atmosphere by rain and deposited in the soil as carbonic acid. Furthermore, under full sunlight carbon dioxide is the limiting factor in photosynthesis. Therefore, the higher the carbon dioxide content of the air, the more that will be removed by photosynthesis and thus stored in plant tissues. Another point is that the estimates of the increase in mean world temperatures during the next half century range between 1.5 and 8.0 degrees Celsius. With such a wide variation in the estimates by different scientists it would seem that there is a great degree of uncertainty as to what is going to happen. During the past century the average world temperature has increased by only 1.5 degrees C. Some authorities say that this can be accounted for by the fact that many of the temperature-recording stations are in urban areas and that the increased temperatures can be accounted for by the heat radiated from all the bricks, concrete and asphalt surfaces that have been added in the cities.

I believe that we should, as a nation, and around the world, do all that we can to cut down on the emission of carbon dioxide and other noxious gases that pollute the atmosphere and furthermore that we should continue to conduct research on the changes in both the constituents in our atmosphere and the buildup in global temperatures.

(In rereading the above paragraph, I realize that I should have stated that in the case of most plants carbon dioxide is the limiting factor under full sunlight. There are a few plants where increases in carbon dioxide in the air will not cause an increase in carbon fixation).

3. I am not an agricultural engineer and cannot answer your question number 3 with any authority. However, I understand that in arid to semi-arid regions drip irrigation, for example, can increase water-use efficiency greatly. I have seen it being successfully used in Egypt on citrus, and, of coures, Israel uses it widely. Furthermore, the maintenance of irrigation ditches, the use of water-retaining linings in the canals improves the efficiency by cutting down on water losses. Without doubt the proper management of irrigation systems can increase the efficiency of water use.

4. Again, I am not an expert on irrigation. However, as you indicate, waterlogging and salinization are important problems in the arid regions. As I understand it, the important factor in preventing salinization is to ensure that there is proper drainage, and, of course, a good supply of fresh water. My experience with rice in Pakistan,for example, has revealed that saline soils can be reclaimed by growing flooded rice for a few years. Of course a proper drainage ditch has to be constructed and then the flood water in the paddy leaches out the excess salts. I cannot answer your question as to whether or not the amount of land damaged by salinity exceeds the amount that is reclaimed by poorly designed irrigation systems every year. I do feel, however, that irrigation experts are fully aware of the problem and are designing systems to avoid problems of waterlogging and salinization.

5. Unfortunately, I do not know of any statistics that reveal the amount of food production that is lost by the expansion of urban areas. I did note in the 1989 issue of "State of the World" put out by the Worldwatch Institute in Washington that China, since 1976 has lost 9 percent of its arable land to the expansion of urban areas. The situation is more severe in the over-populated and highly industrialized countries such as Japan. It will indeed become an ever-increasing problem in many less-developed countries. In my search here at home on information on the subject I came across an article by Parker G. Marden

entitled Population Distribution and the Green Revolution published in 1973 as a part of a symposium at Cornell University on Food, Population and Enployment. Dr. Marden gave some estimates of the change in rural versus urban population from 1950 through the year 2000 in the developed and less-developed countries. He showed that in 1950 in the more developed nations the urban population constituted 51 percent of the total, and that by the year 2000 it would be 81 percent of the total. In the less-developed countries in 1950 only 16 perecent of the population was urban but by the year 2000 it was estimated that this figure would increase to 43 percent, thus more than three times the proportion of 50 years earlier. Marden's estimates do not seem far off as we look at the figures for 1989.

There are, of course, some advantages to a large urban population provided that they can be employed and if the agricultural production can be increased along with such infrastructures as farm to market roads, because thus you create markets for agricultural products and thereby decrease rural poverty. As you know, statistics show that the degree of rural poverty is often greater than that of urban poverty in many of the poorer countries.

The responses to your questions that I have given are inadequate. If I had a good university library available to me I could do a better job.

As you know from my previous testimony I feel that the world's most critical problem is that of over-population and that unless mankind can control his numbers the world will exhaust its life-sustaining resources and that life for many of its inhabitants will become intolerable.

With best wishes.

Sincerely,